NVIS Antenna

How to get saturation coverage in the skip zone

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Problem statement

During disasters, WA communicators need to be able to reliably communicate with W7EMD at Camp Murray (State EOC) & other sites around the region via HF on 75 (Pri.), 60 and 40 mtrs (Sec.)

Goal

- Traffic quality statewide communications using a single transportable antenna and a 100 W transmitter ***without an external tuner***

Desirable attributes

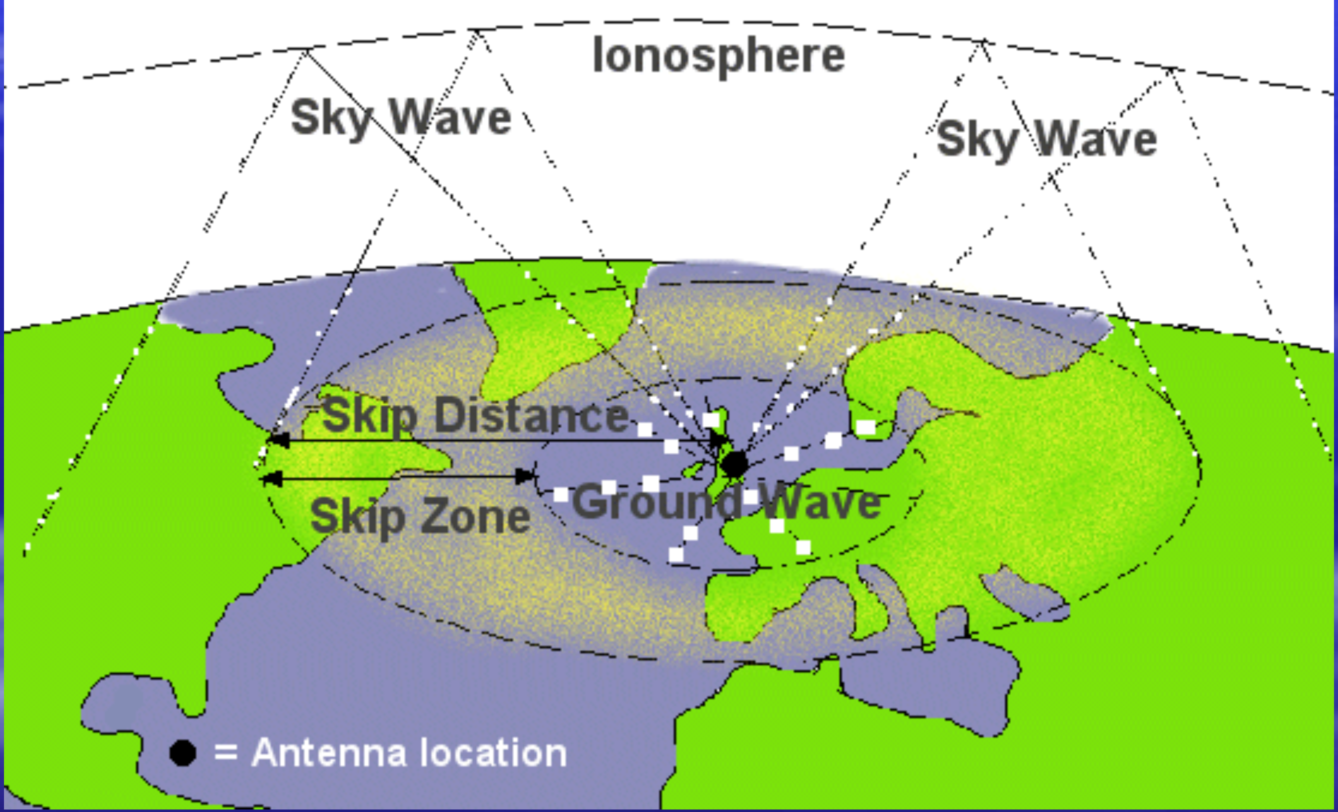
- Resonant at 7245 kHz, 5373 kHz and 3985 kHz
- Omni-directional
- Coverage of WA, OR, ID and BC
- Portable
- Easy for one person to erect

What is NVIS?

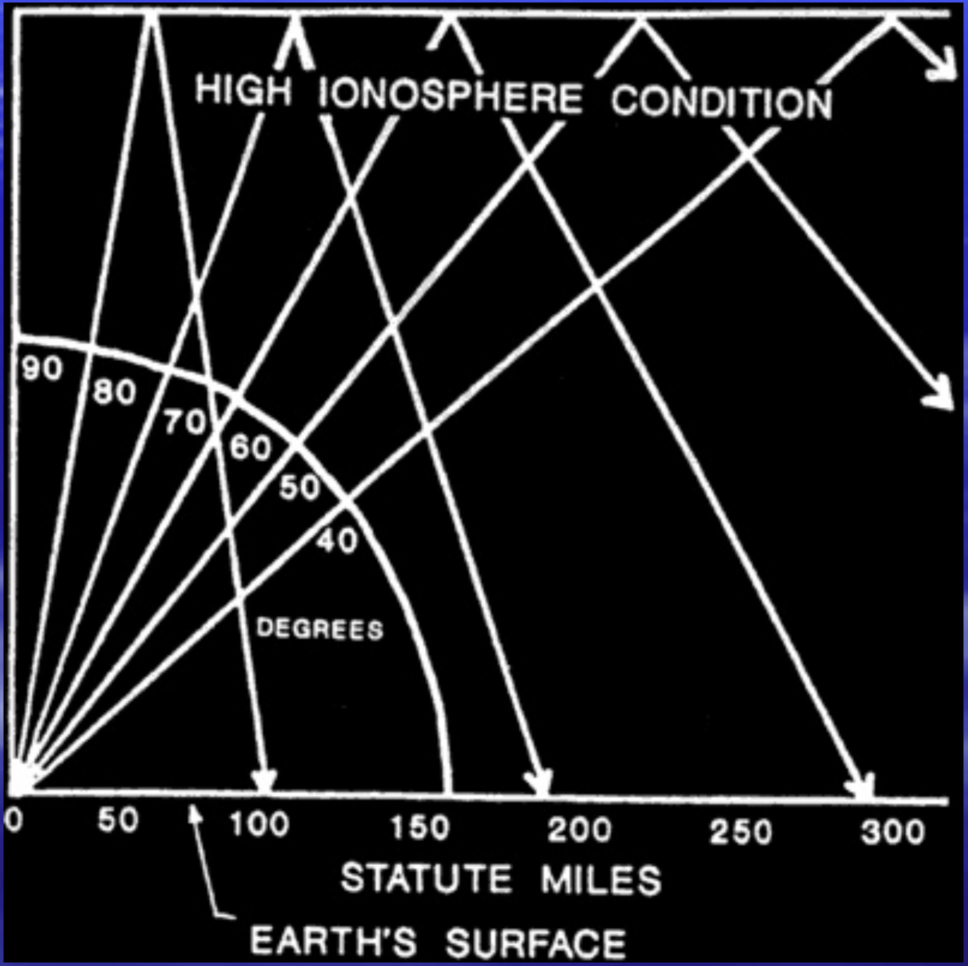
- Near
- Vertical
- Incident
- Skywave

- Cloud Warmer

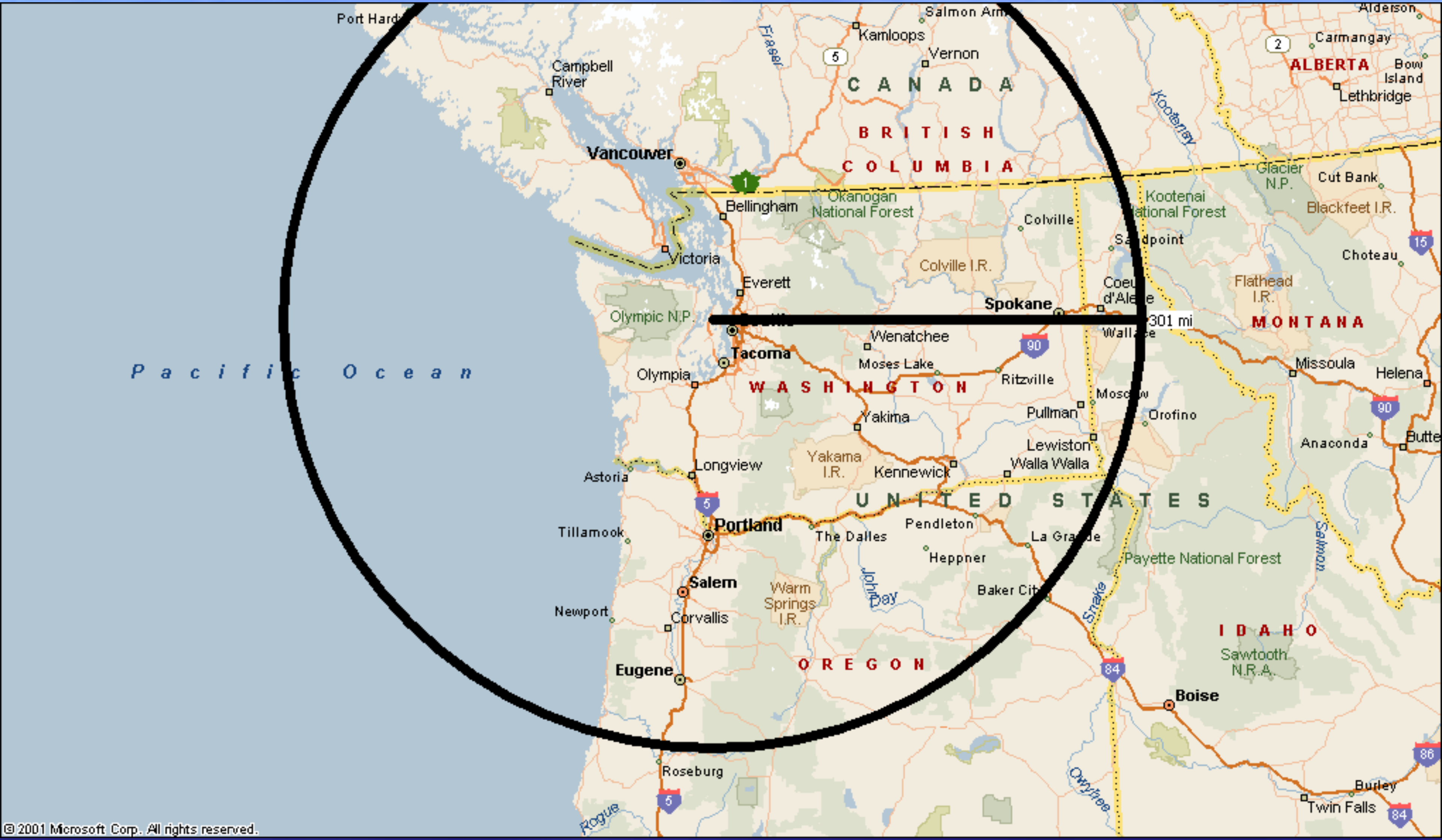
Propagation Theory



NVIS Effect


HIGH IONOSPHERE CONDITION
DEGREES
STATUTE MILES
EARTH'S SURFACE

300 Mile Coverage



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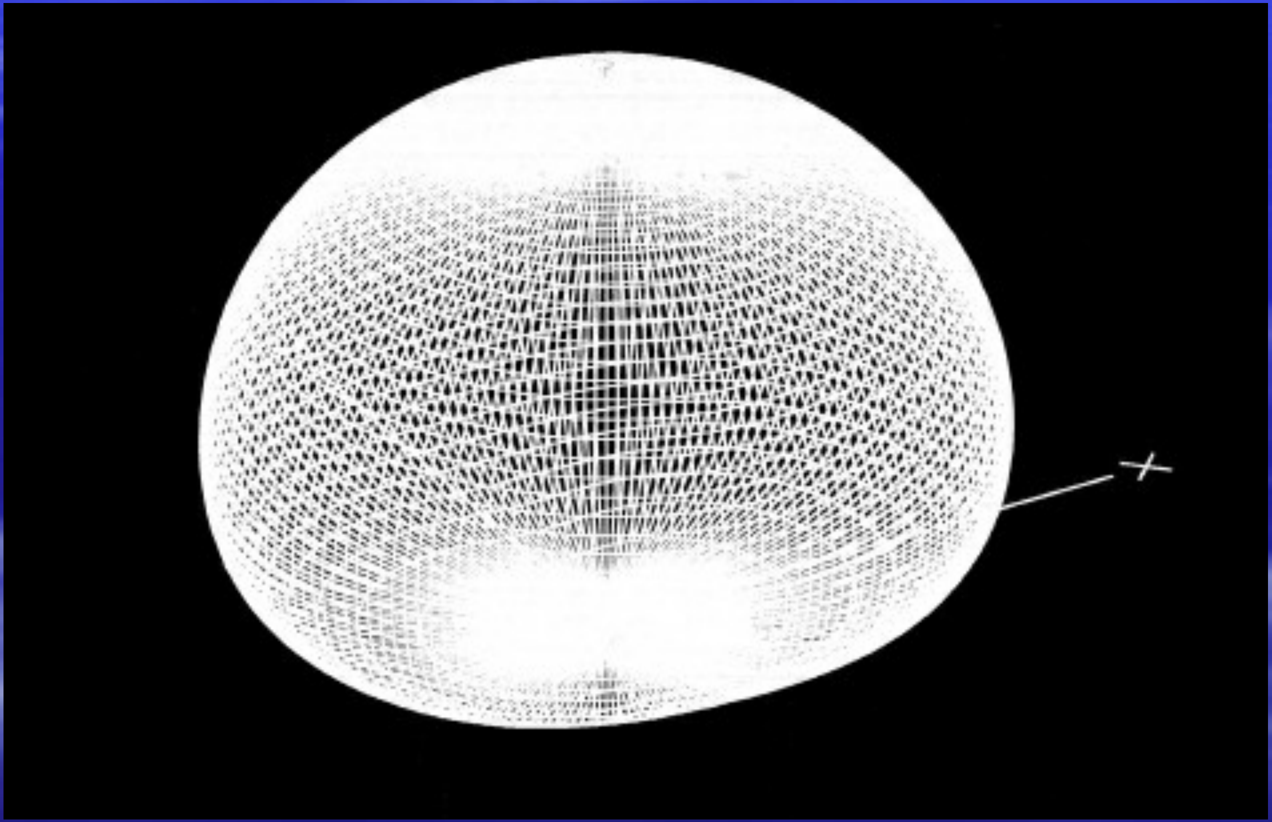
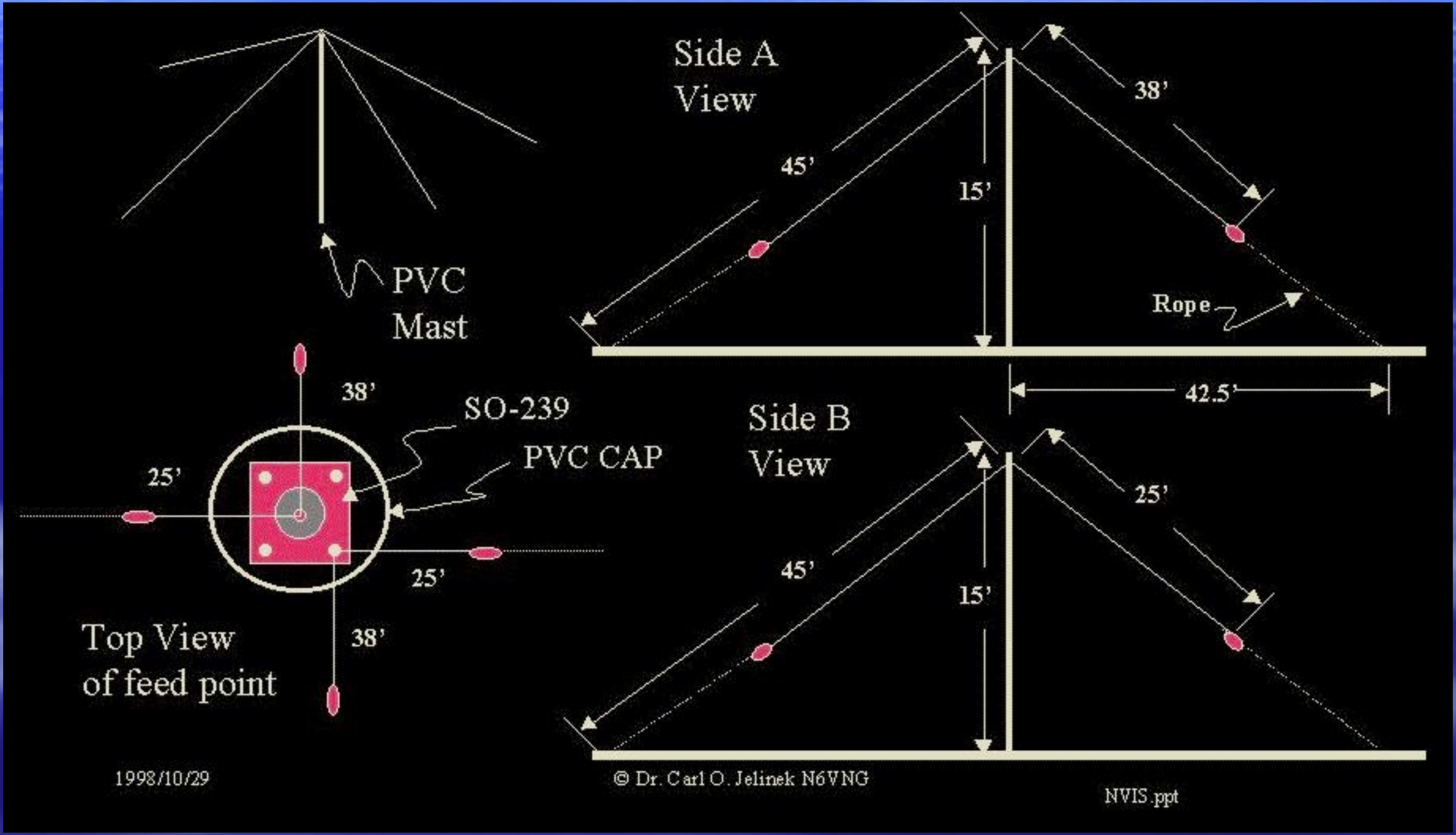
Omni Pattern



The Technical End Of Things

- Dr. Jelinek's design
- Modifying the original design to work on 75, 60 & 40 meters without a tuner
- Tweaking for optimum performance

Drawing Of Original Concept



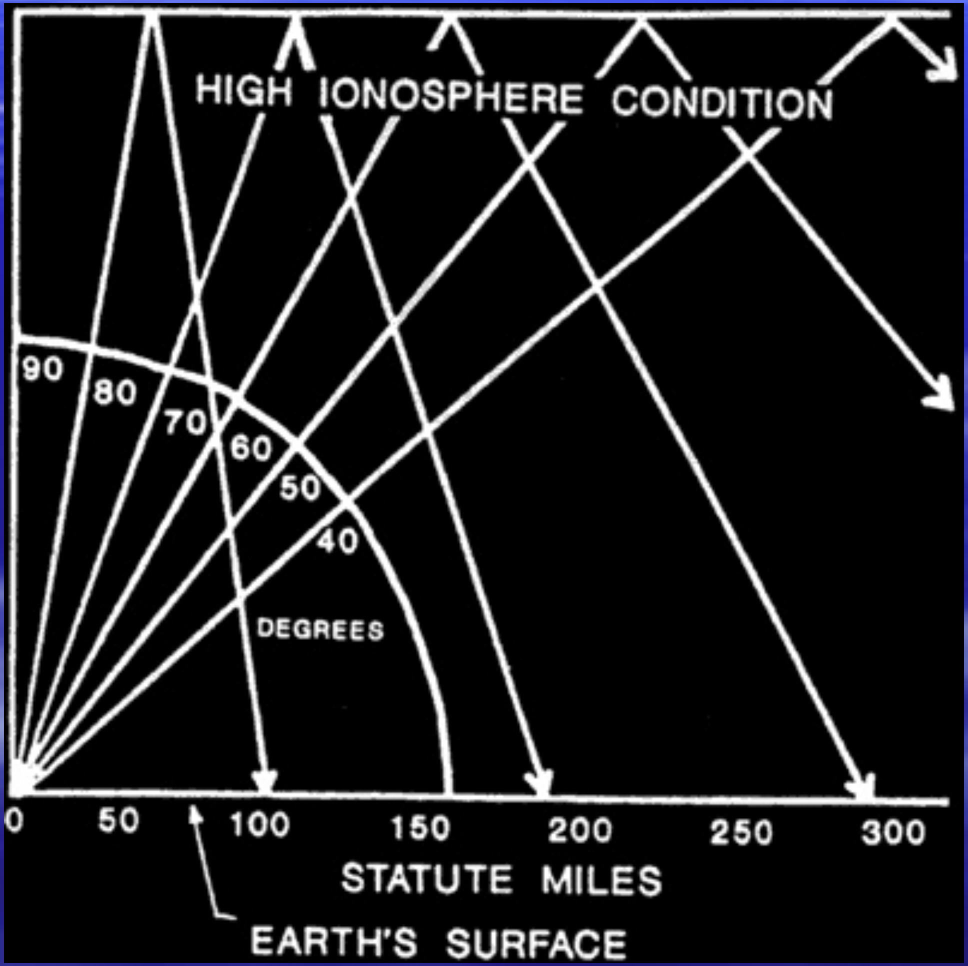
NEC2 Considerations

- Original design using EZNEC replaced by NEC2 (Numerical Electromagnetic Code)
- Derived from original NEC Provides accurate gain data for radiators very close to the ground
- Gain figures vary with ground conditions

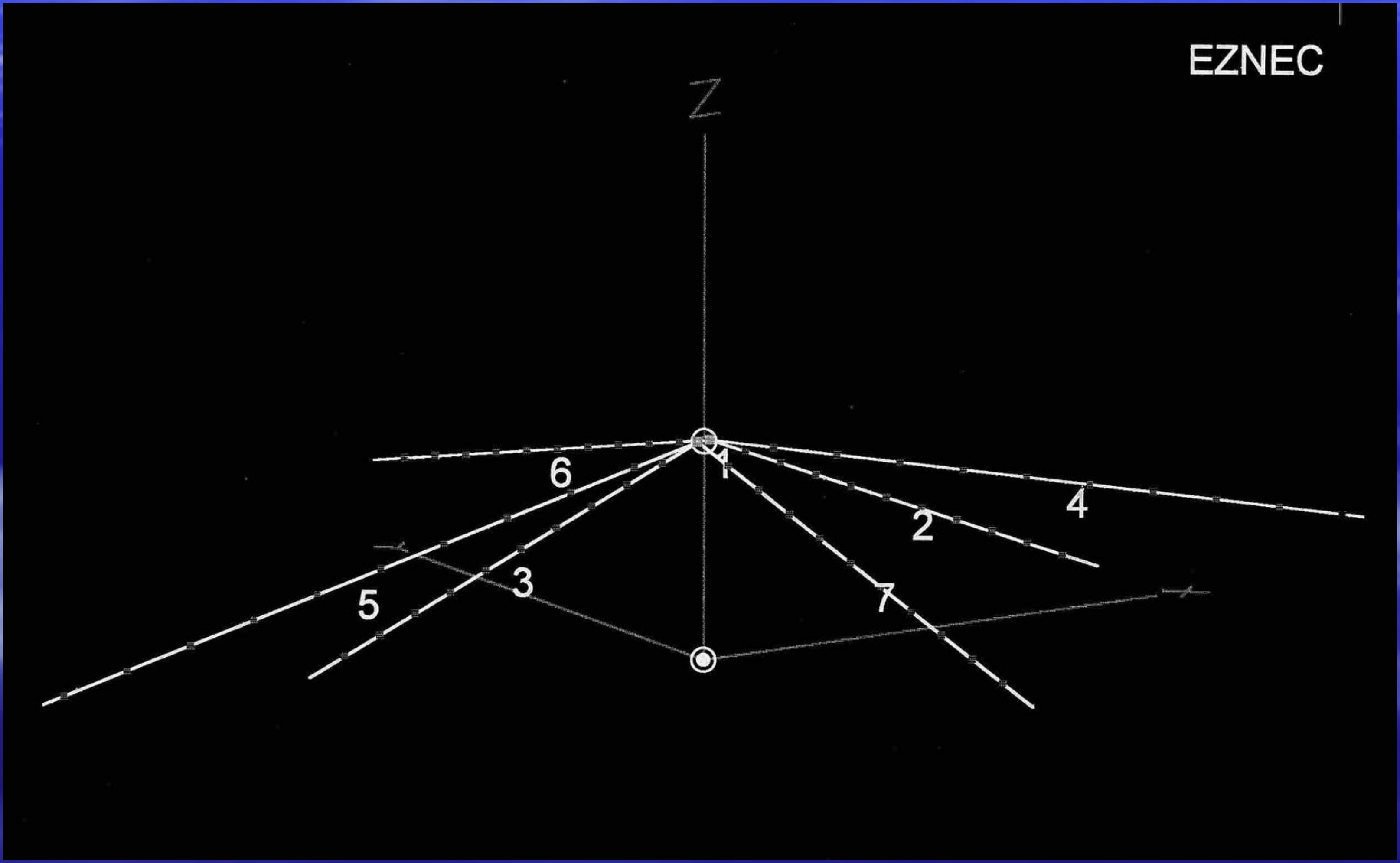
Propagation Considerations

- “D” layer losses
- Ionospheric scattering for vertical propagation
- Importance of critical frequency

Ionosphere Effect



Antenna Skeleton

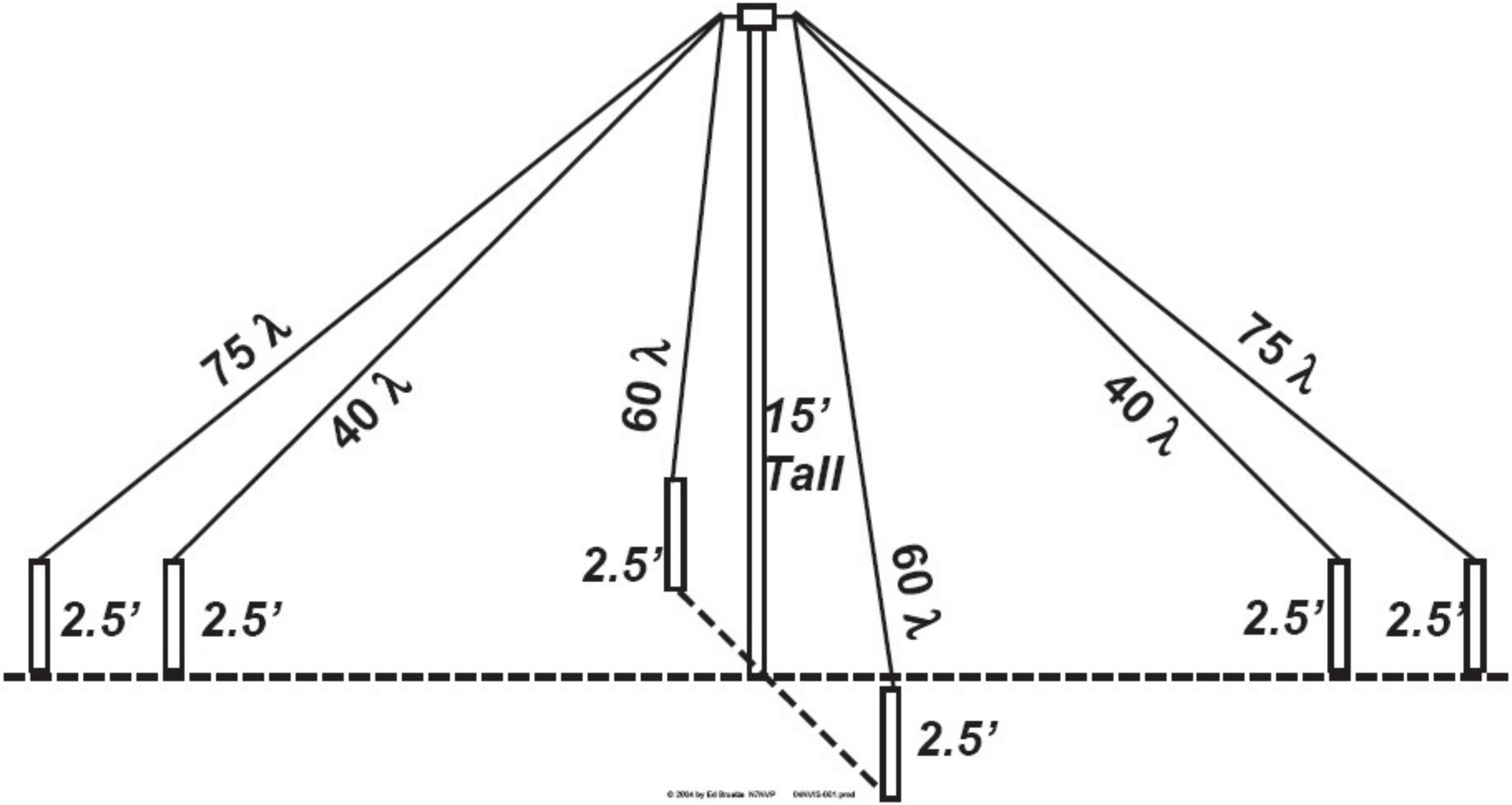


Element lengths

- 75 Mtr legs = 58.32 ft
- 60 Mtr legs = 43.00 ft
- 40 Mtr legs = 34.08 ft

- Prune these lengths to meet your ground conditions

NVIS Tri-Band Antenna for 75, 60, & 40 Meters.
Side View



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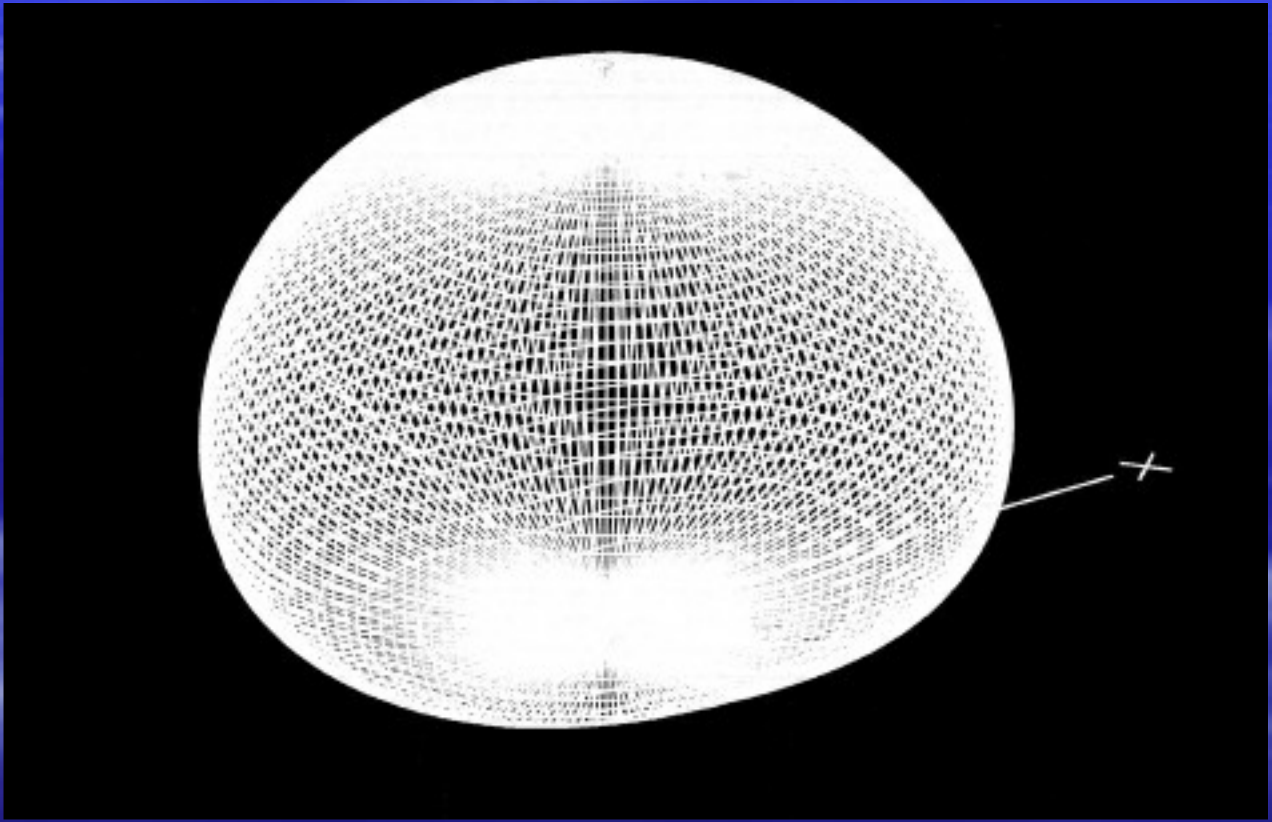
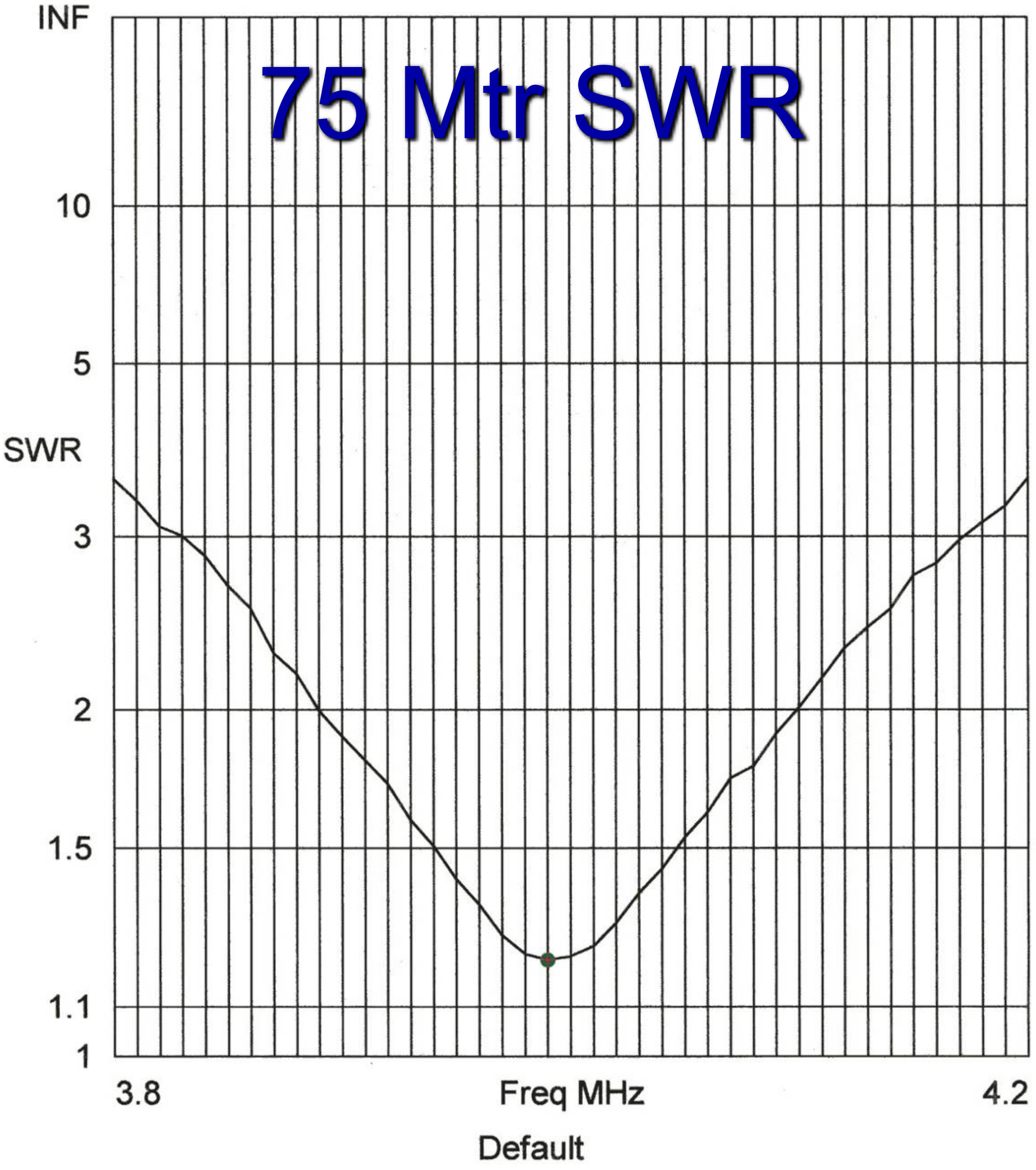
Omni Pattern

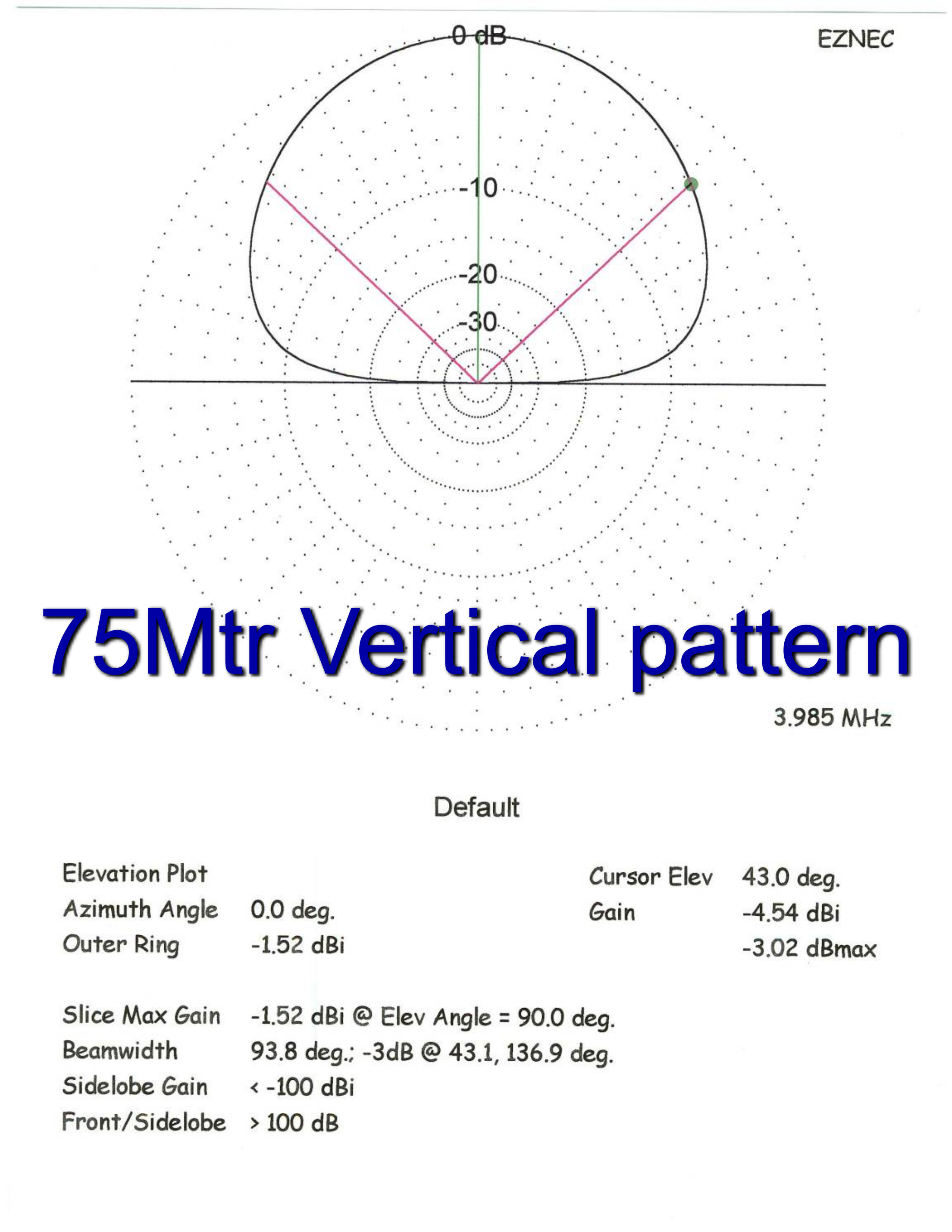


75 Mtr SWR



Freq	3.99 MHz	Source #	1
SWR	1.21	Z0	50 ohms
Z	59.72 - j 3.177 ohms		

75Mtr Vertical pattern

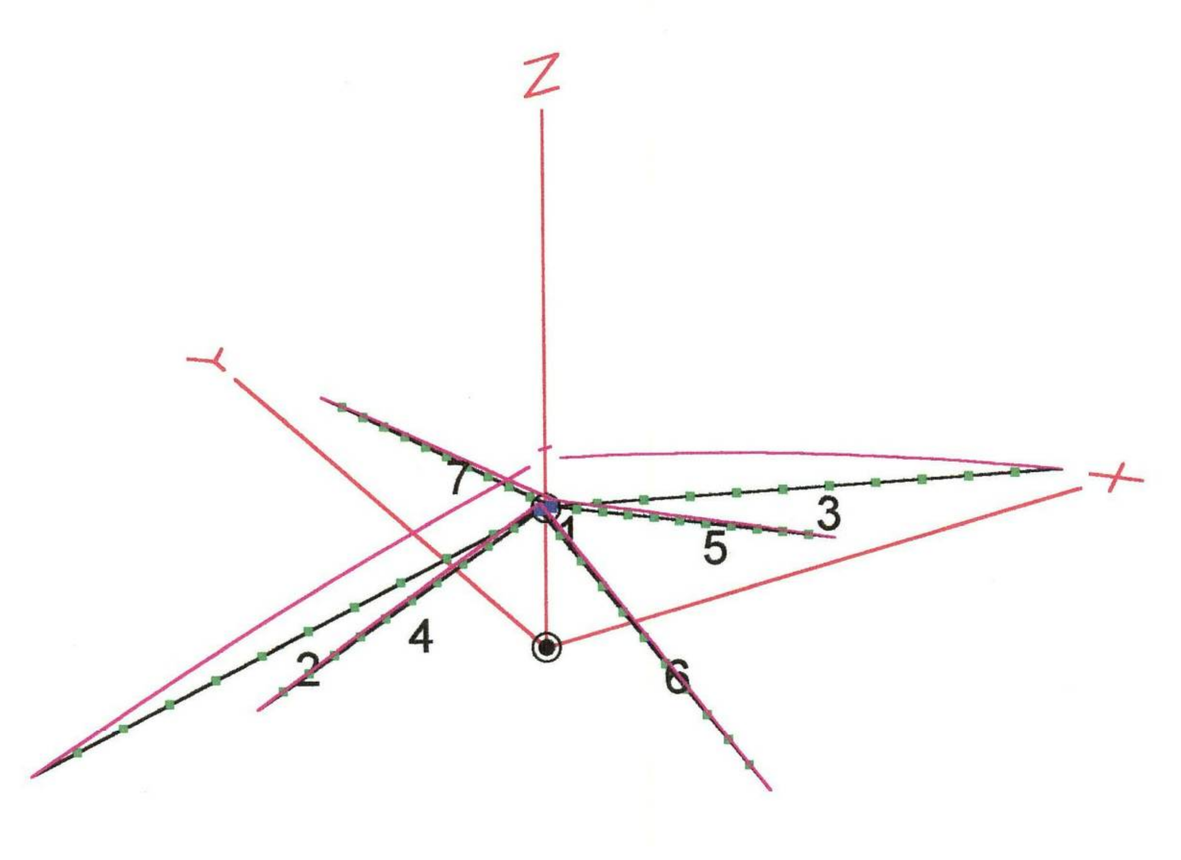


Default

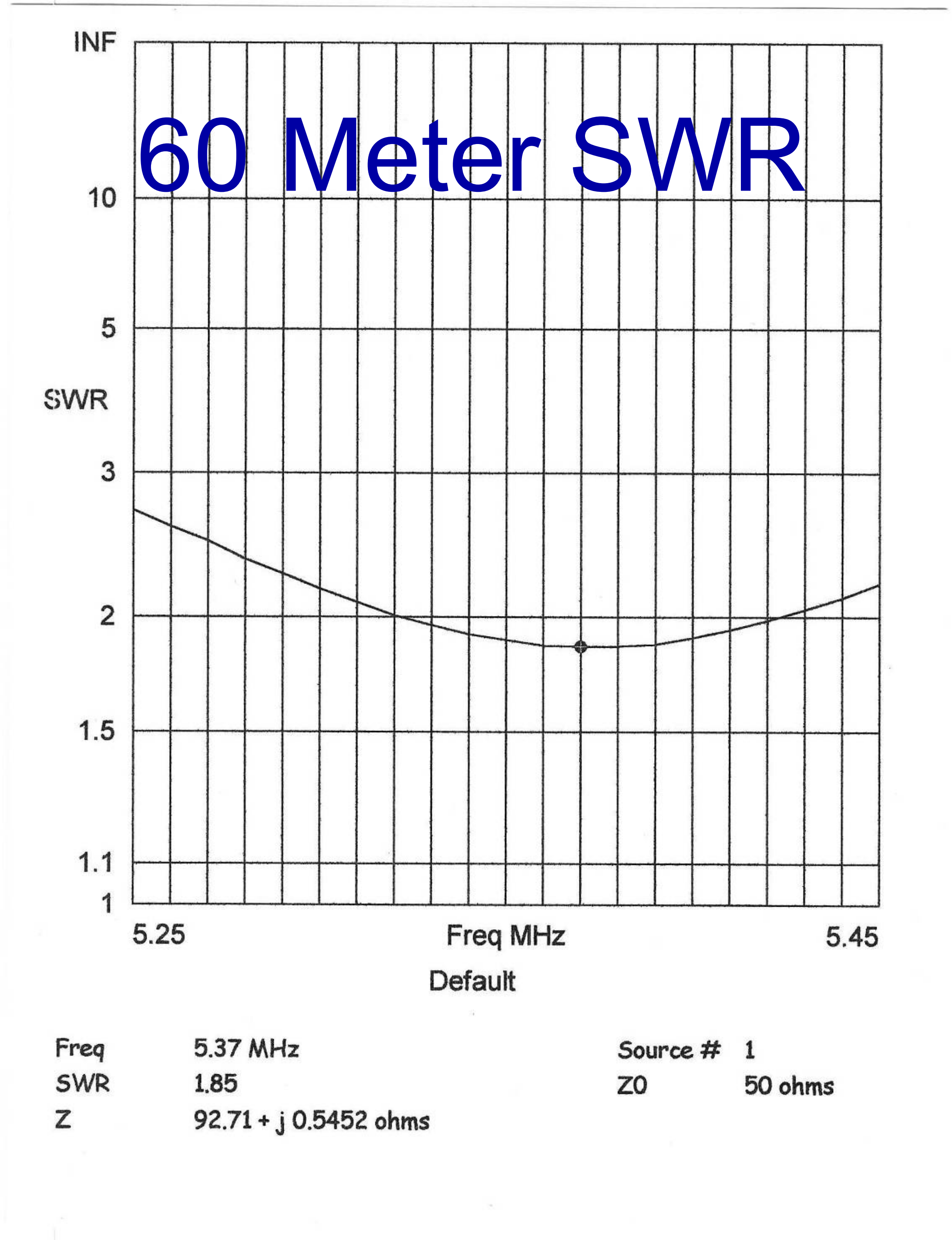
Elevation Plot		Cursor Elev	43.0 deg.
Azimuth Angle	0.0 deg.	Gain	-4.54 dBi
Outer Ring	-1.52 dBi		-3.02 dBmax

Slice Max Gain	-1.52 dBi @ Elev Angle = 90.0 deg.
Beamwidth	93.8 deg.; -3dB @ 43.1, 136.9 deg.
Sidelobe Gain	< -100 dBi
Front/Sidelobe	> 100 dB

75 Meter Current Distribution

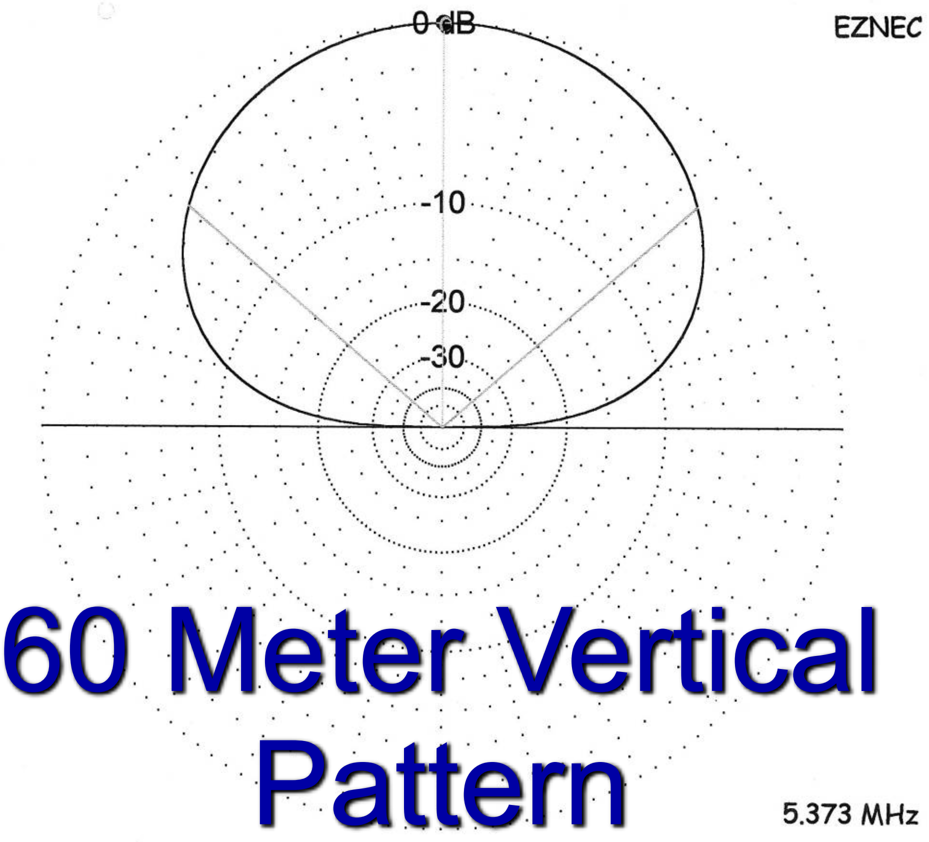


60 Meter SWR



```
Freq    5.37 MHz                      Source #   1
SWR     1.85                          Z0         50 ohms
Z       92.71 + j 0.5452 ohms
```

60 Meter Vertical Pattern

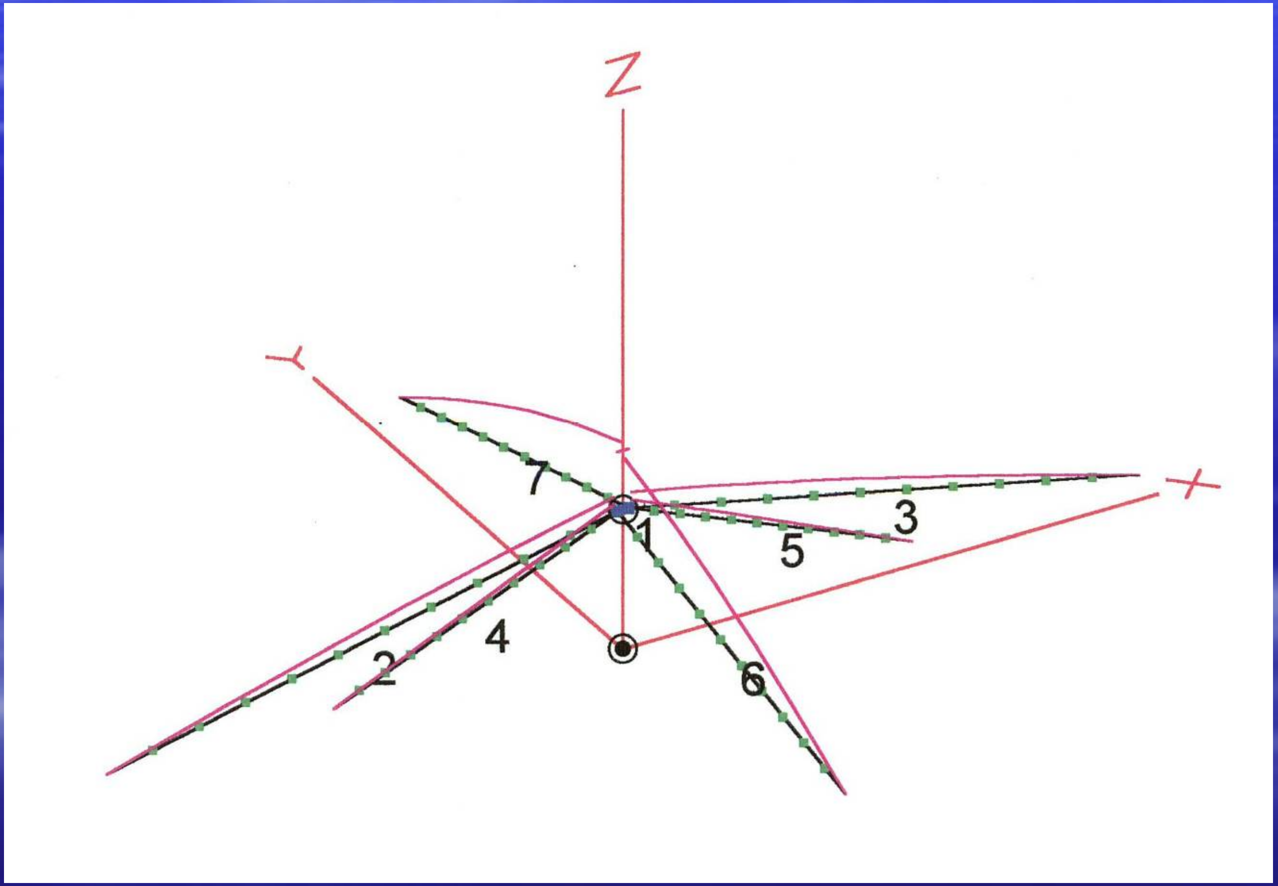


Default

Elevation Plot		Cursor Elev	90.0 deg.
Azimuth Angle	0.0 deg.	Gain	-1.58 dBi
Outer Ring	-1.58 dBi		0.0 dBmax

Slice Max Gain -1.58 dBi @ Elev Angle = 90.0 deg.
Beamwidth 98.6 deg.; -3dB @ 40.7, 139.3 deg.
Sidelobe Gain < -100 dBi
Front/Sidelobe > 100 dB

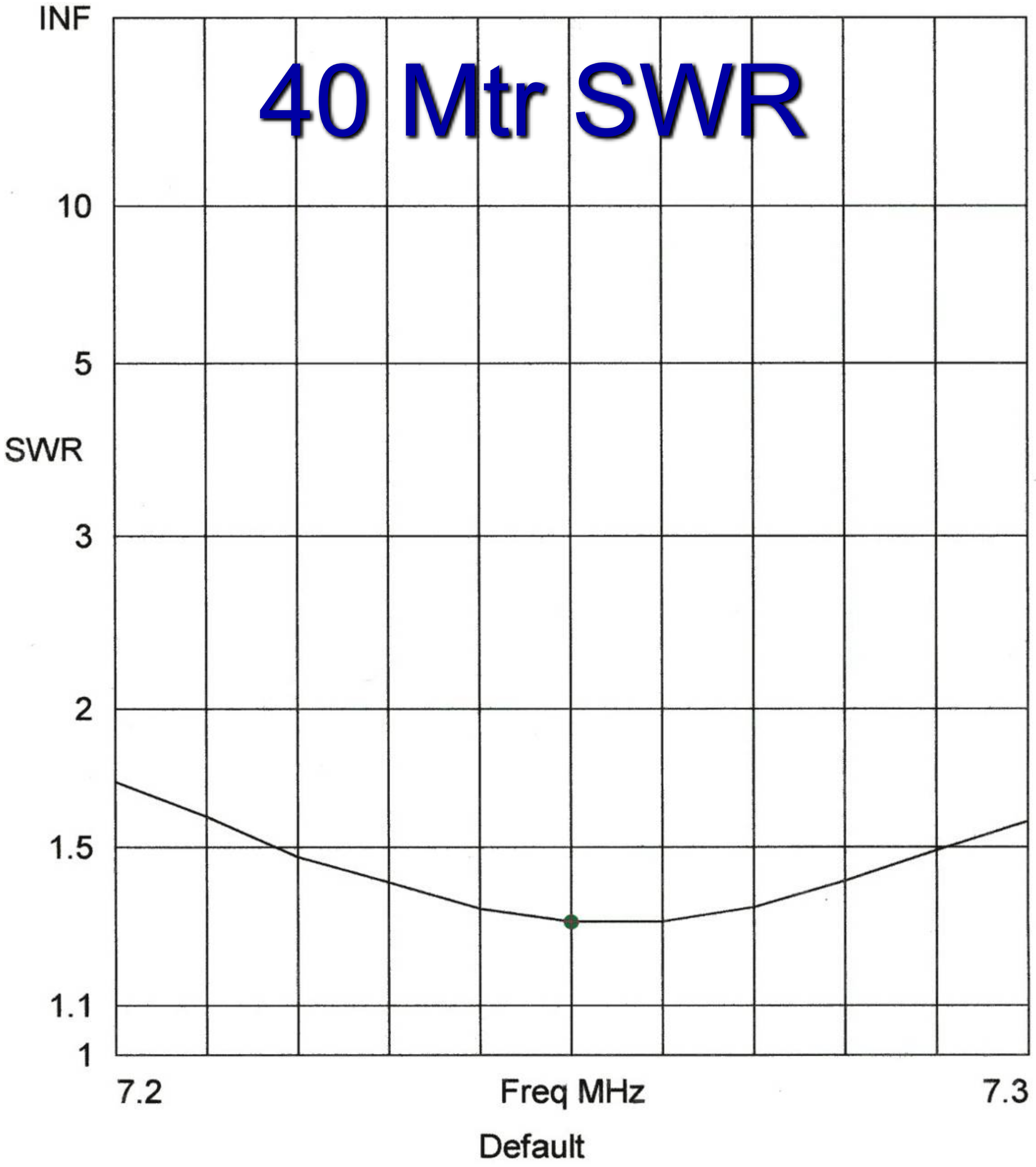
60 Meter Current Distribution



60 Meter Power Considerations

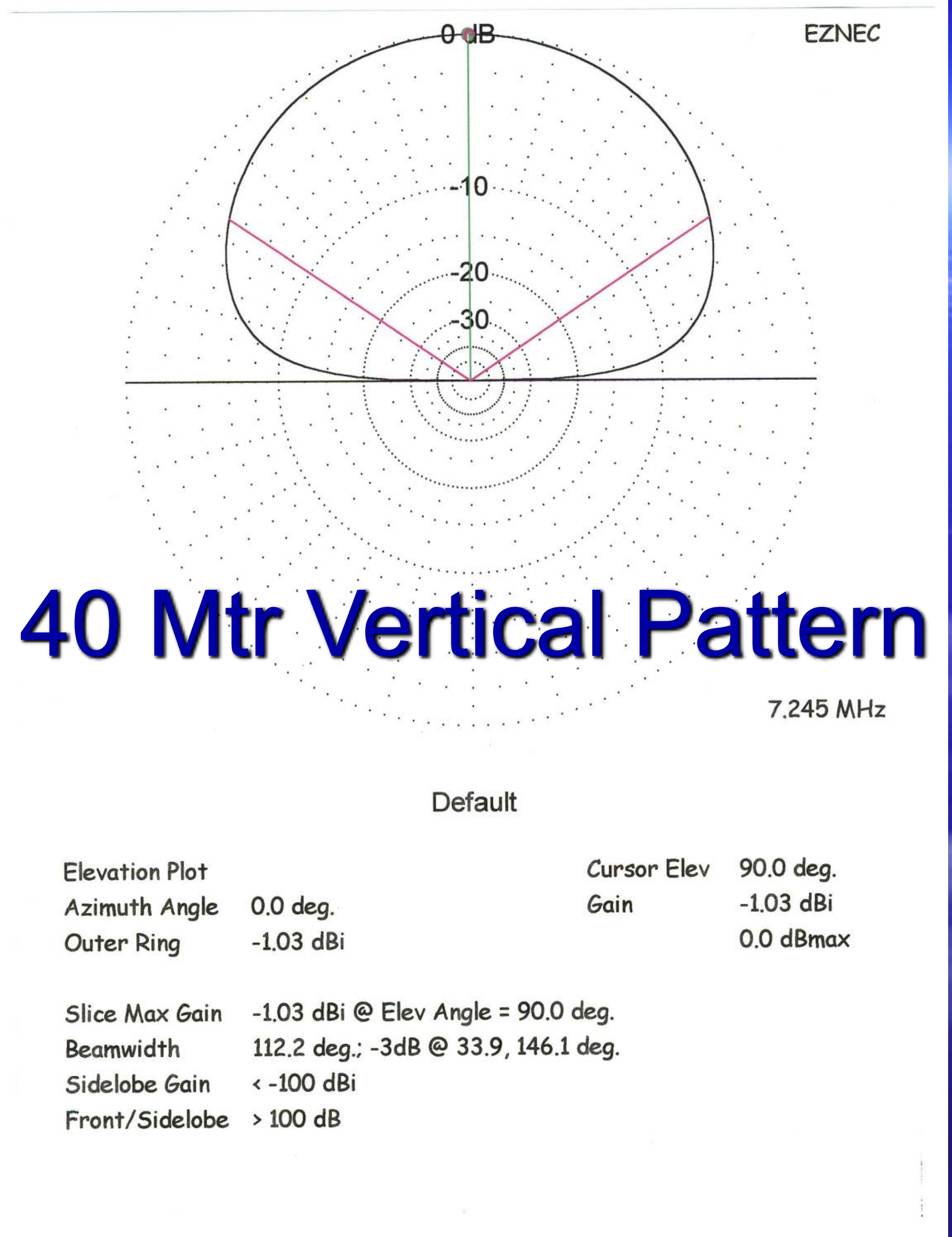
- 50W ERP limitation
- Antenna gain
- Feedline loss
- Using this design, run a 100W radio at full power
- QST Feb. 2004

40 Mtr SWR



Freq	7.25 MHz	Source #	1
SWR	1.3	Z0	50 ohms
Z	64.62 - j 1.904 ohms		

40 Mtr Vertical Pattern

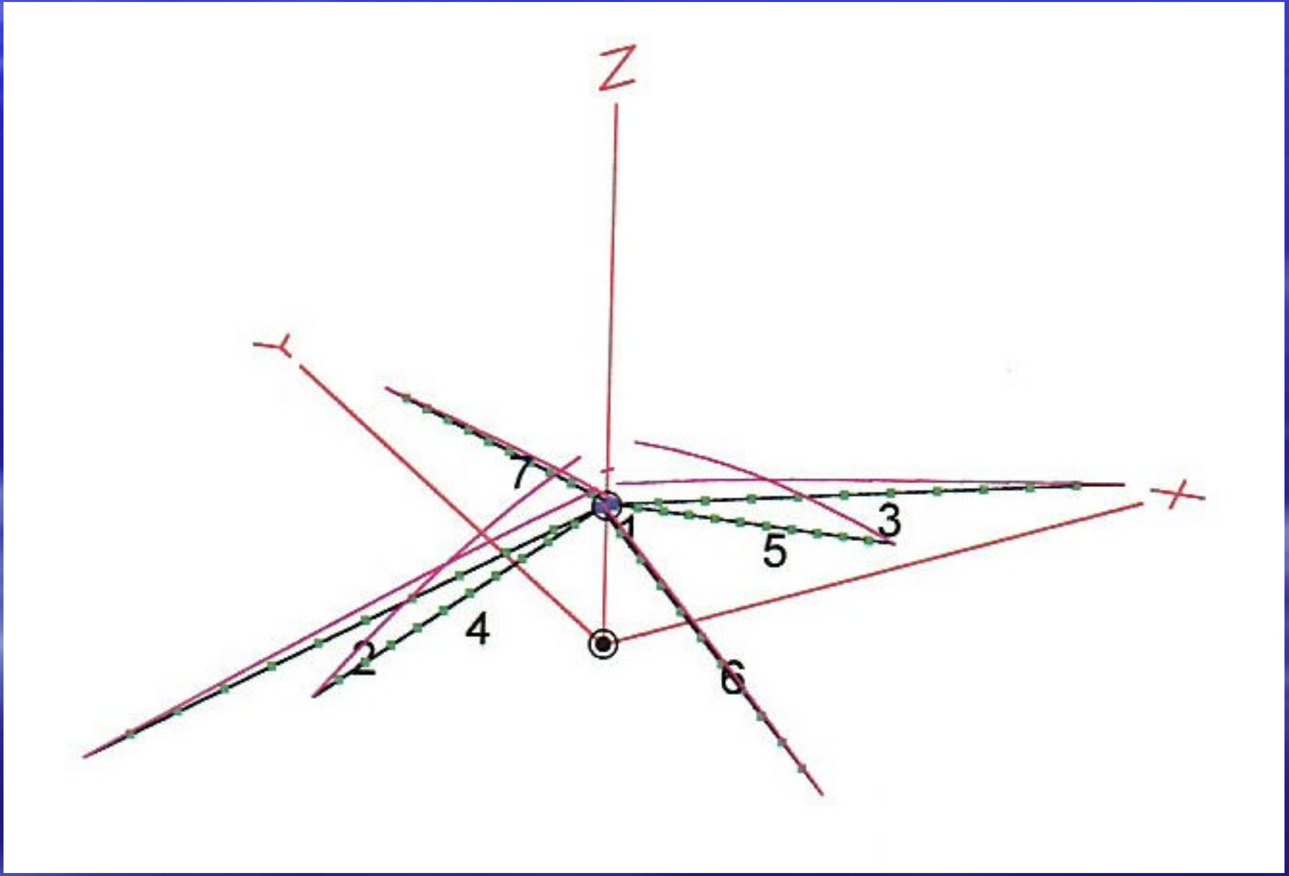


Default

Elevation Plot		Cursor Elev	90.0 deg.
Azimuth Angle	0.0 deg.	Gain	-1.03 dBi
Outer Ring	-1.03 dBi		0.0 dBmax

Slice Max Gain	-1.03 dBi @ Elev Angle = 90.0 deg.
Beamwidth	112.2 deg.; -3dB @ 33.9, 146.1 deg.
Sidelobe Gain	< -100 dBi
Front/Sidelobe	> 100 dB

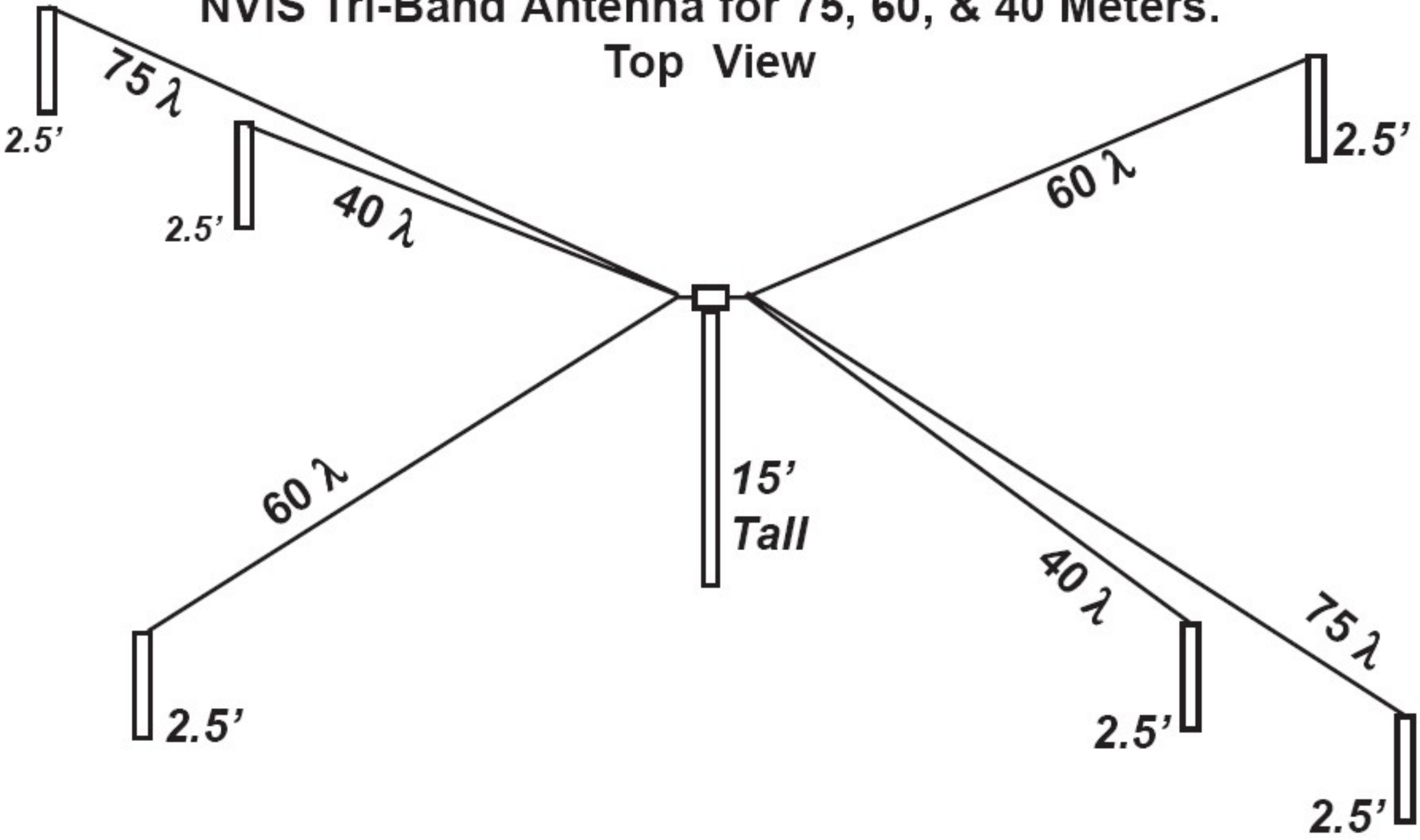
40 Meter Current Distribution



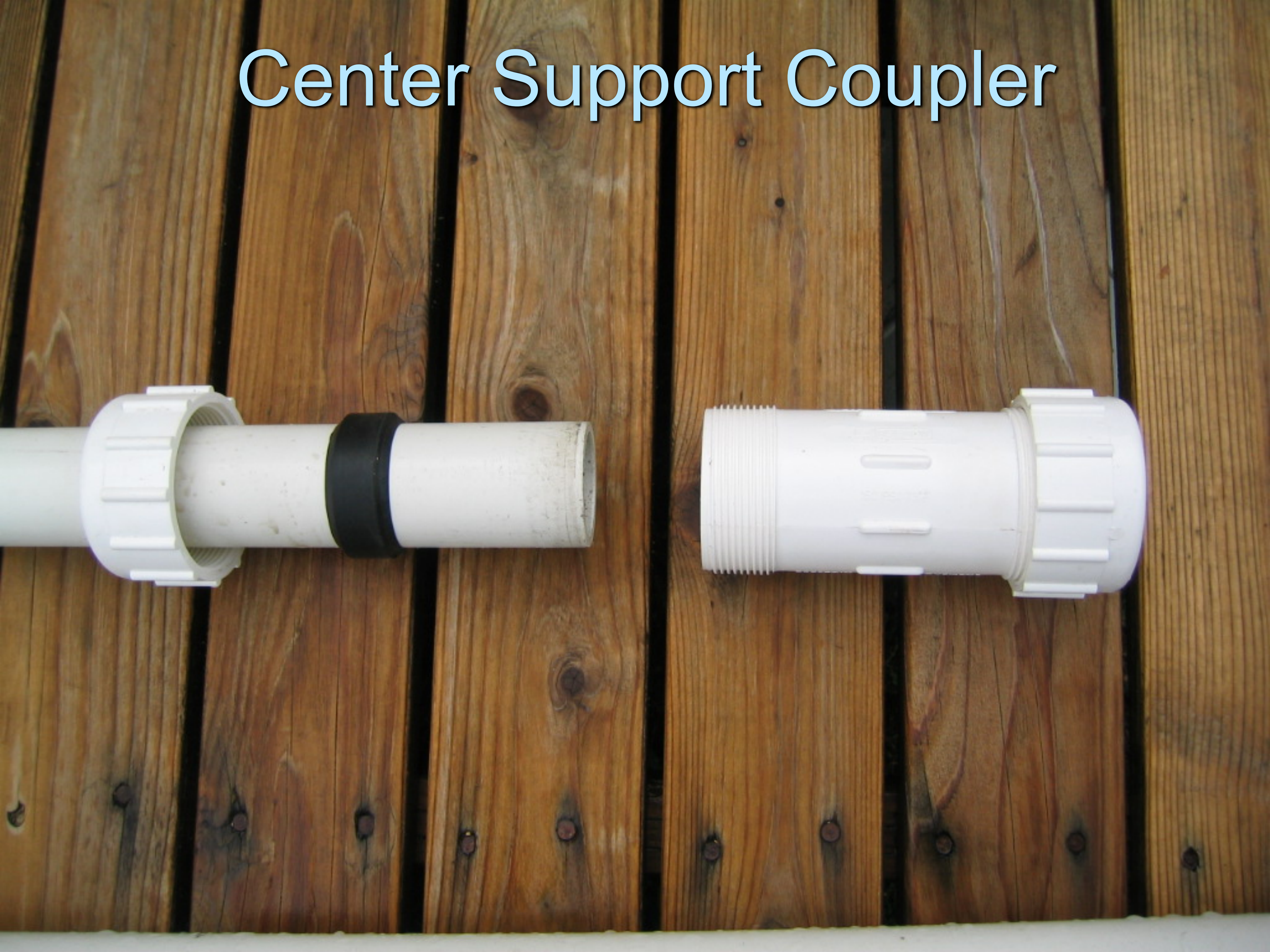
How it went together

- Materials
- Construction
- Modifications

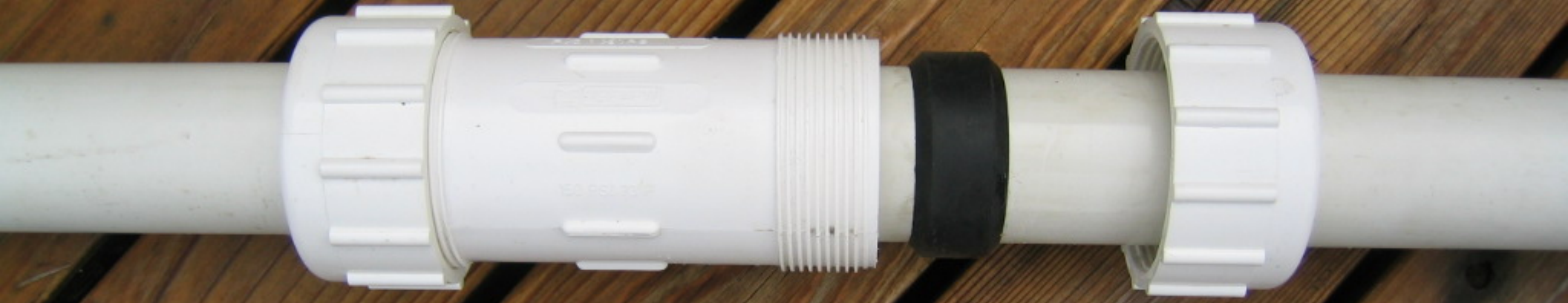
NVIS Tri-Band Antenna for 75, 60, & 40 Meters.
Top View



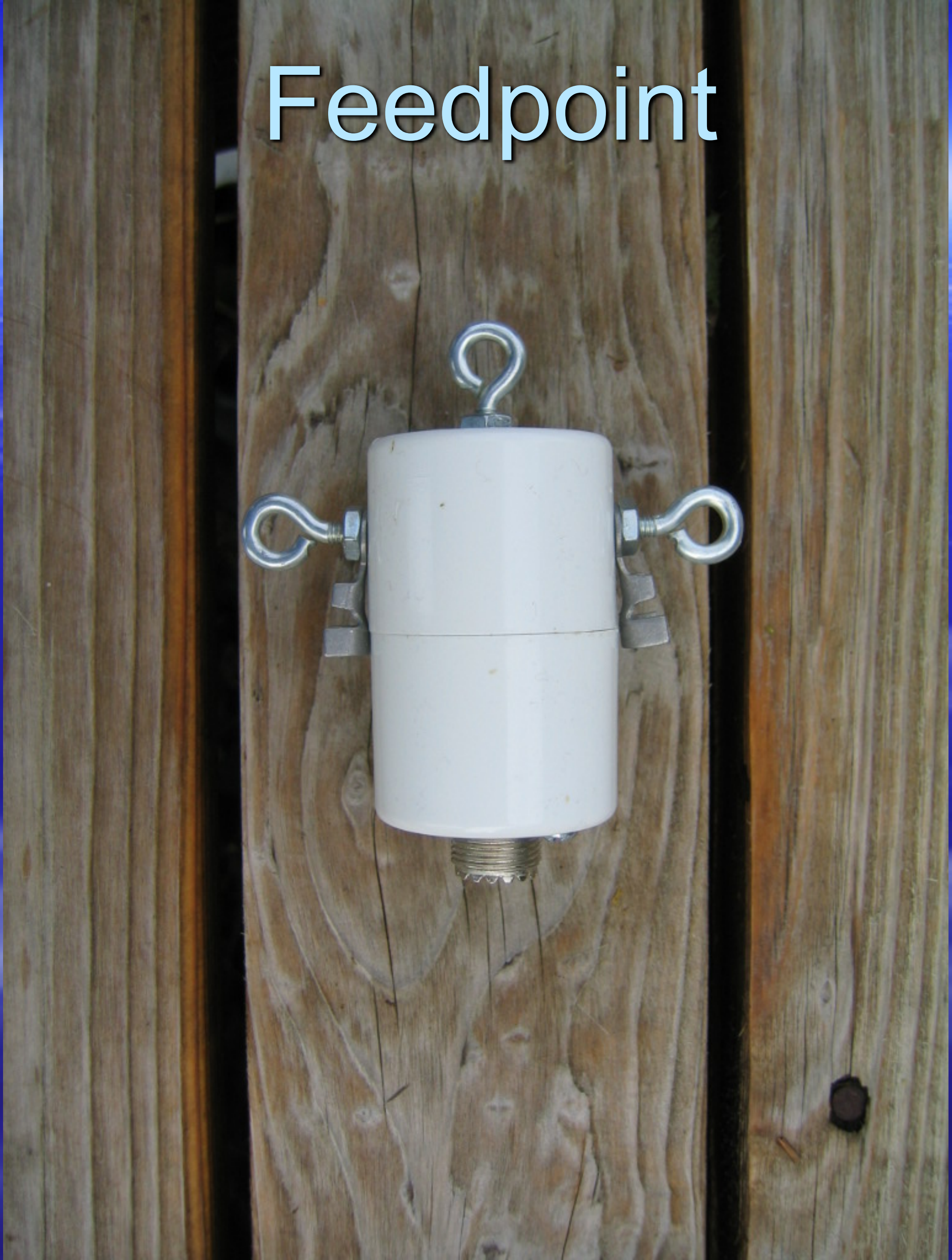
Center Support Coupler



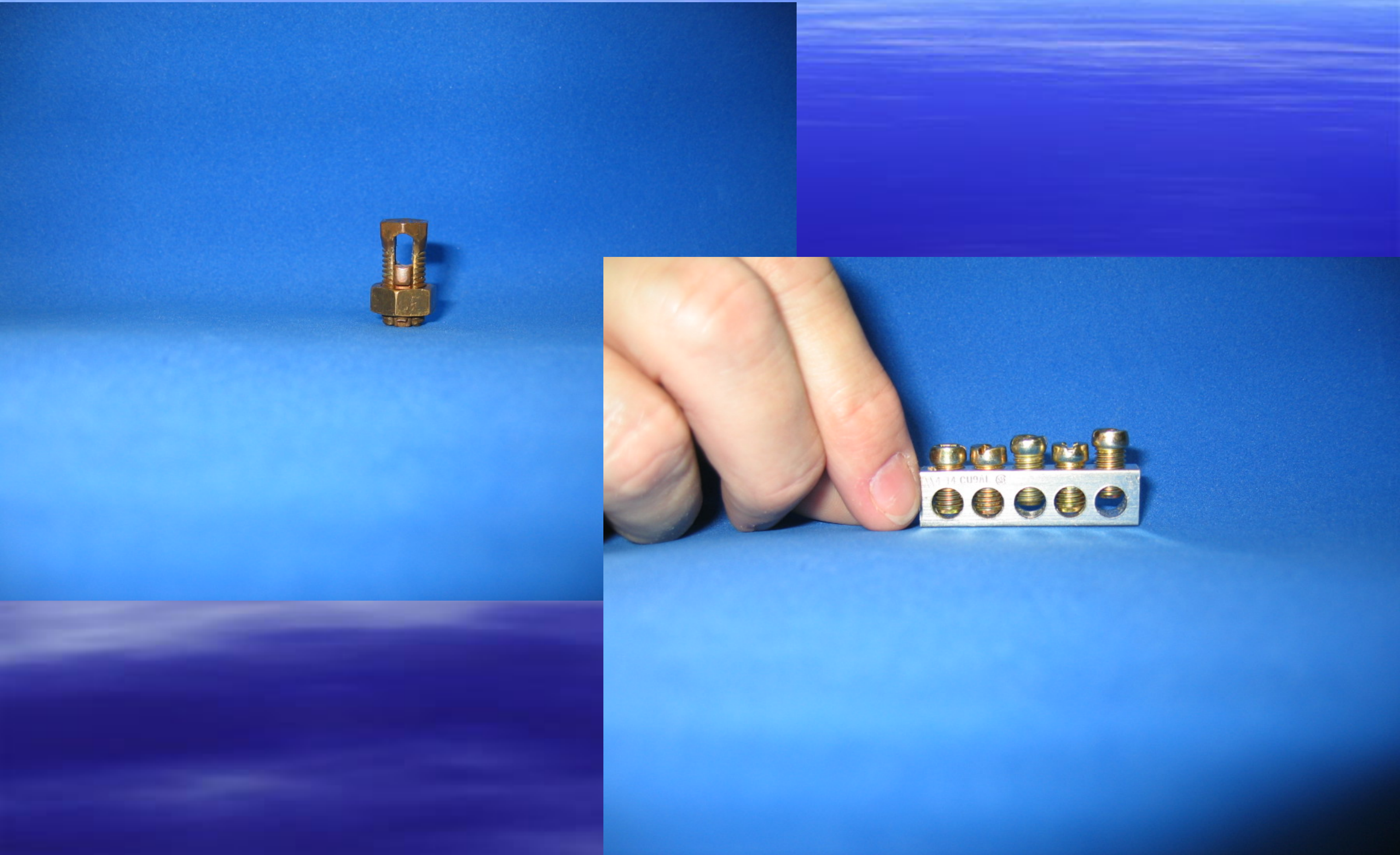
Center Support Coupler



Feedpoint



Wire Connectors



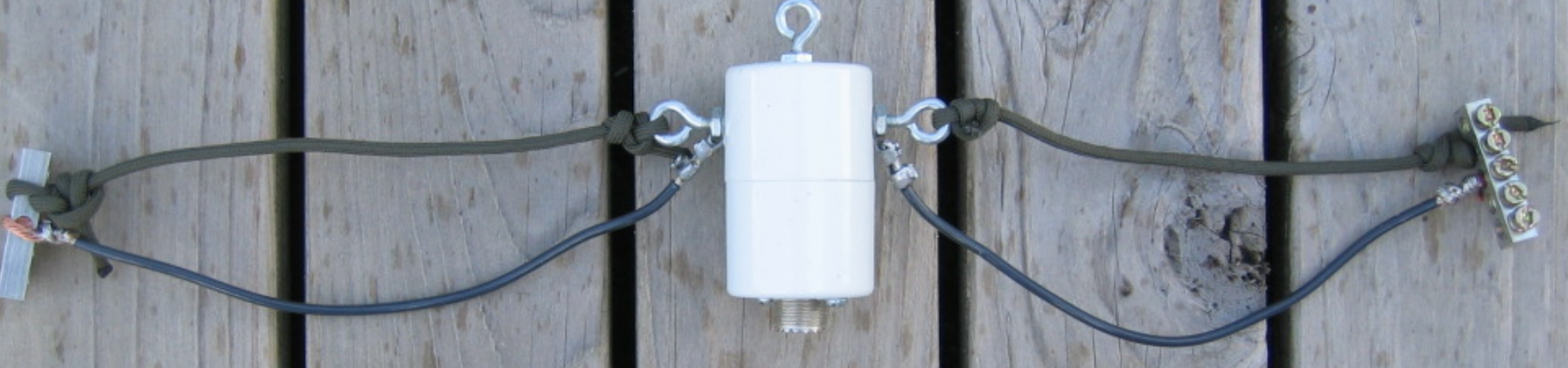
Parts list

- 2 1.5 in x 10 ft Schedule 40 PVC pipe – cut to 7.5 ft lengths
- 1 1.5 in. compression coupler (joint connector)
- 1 1.5 in. slip coupler
- 2 1 in x 10 ft Schedule 40 PVC pipe – cut to 2.5 ft lengths (6 ea needed)
- 6 1 in end caps
- 6 5/8 in Schedule 20 PVC pipe – Cut to 6 in lengths – Drill hole for wire (6 ea needed)
- 1 6 ft “T” fence post (fits inside center support)

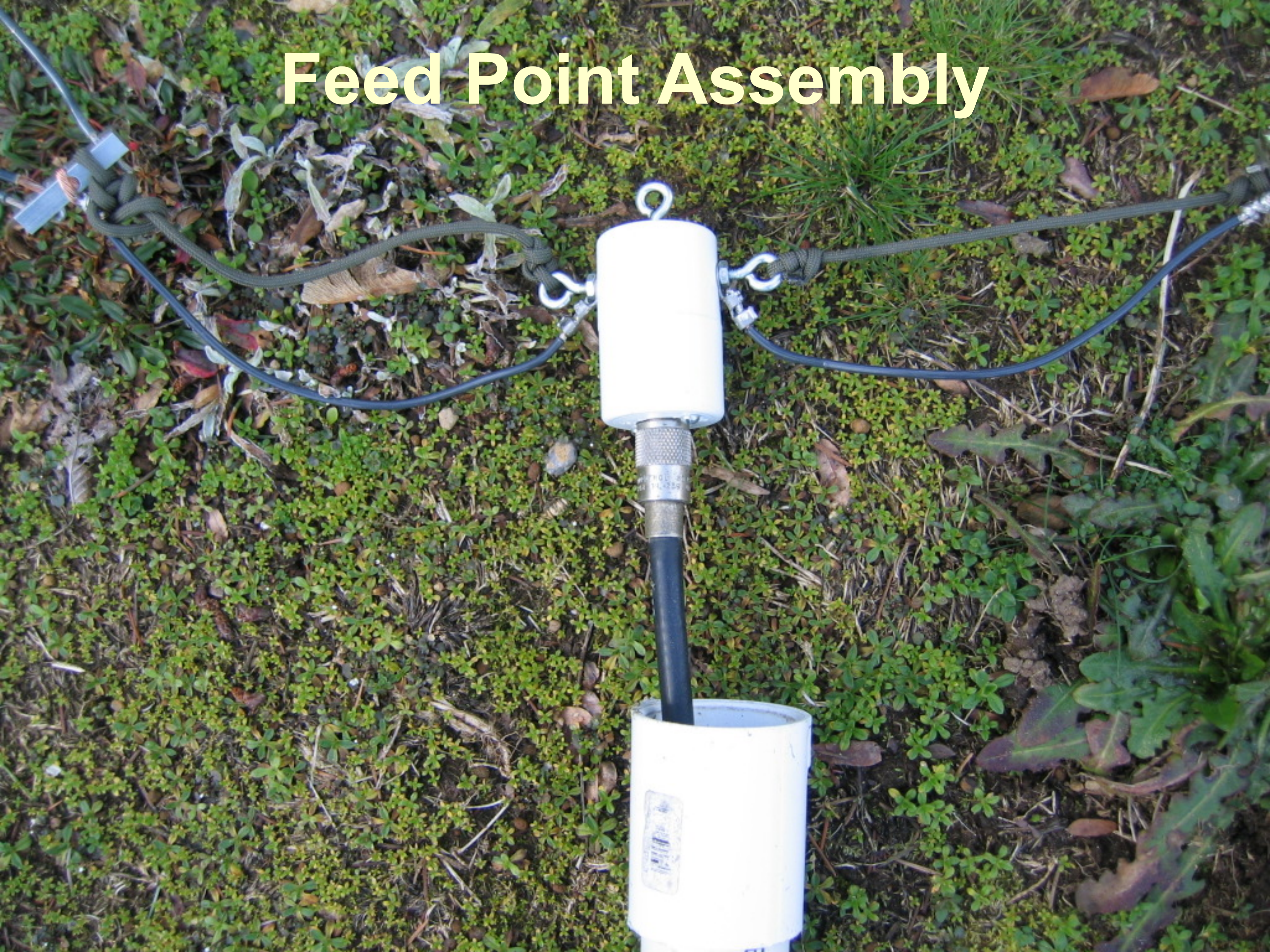
Parts list (Cont.)

- 6 18 in metal stakes
- 1 50 Ohm feed point (Dipole center insulator)
- 275 ft antenna wire – insulated 14 ga.
- 2 8.5 in. wire pig tails – transition from feed point to wire elements
- 2 Short non-conductive strain reliefs
- 2 Split bolts or 5 hole grounding bars
- Coax to reach the transmitter

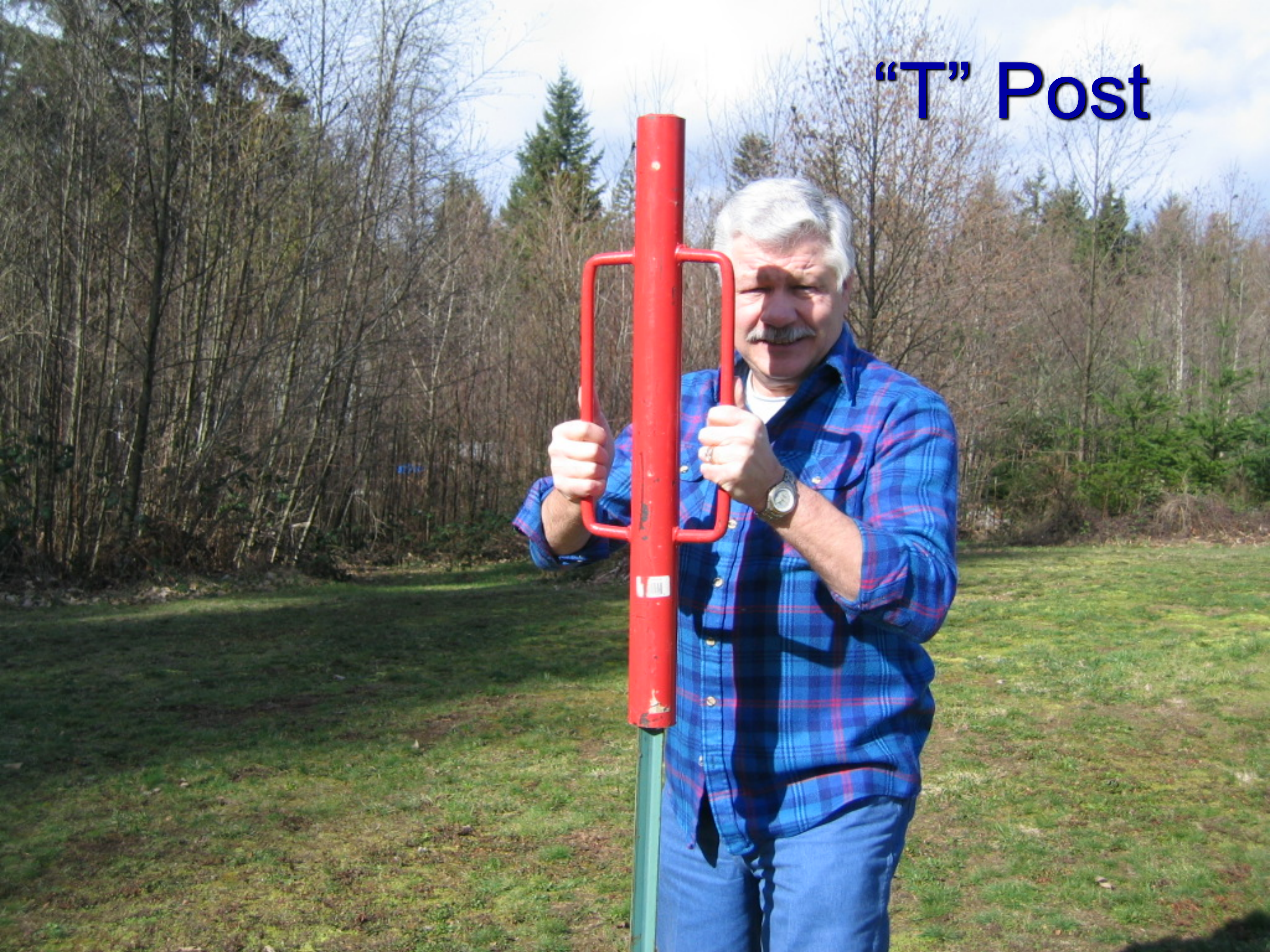
Feed Point



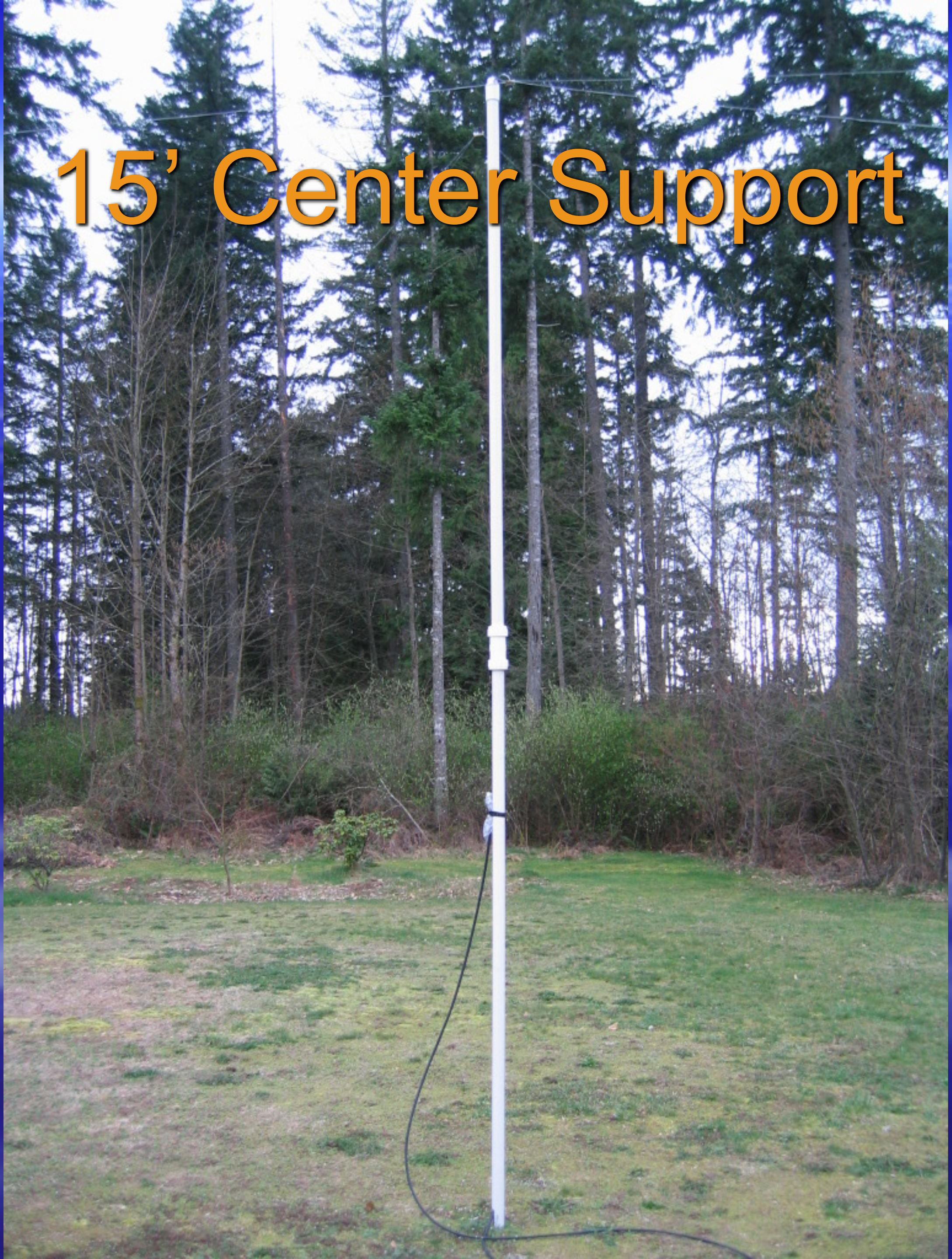
Feed Point Assembly



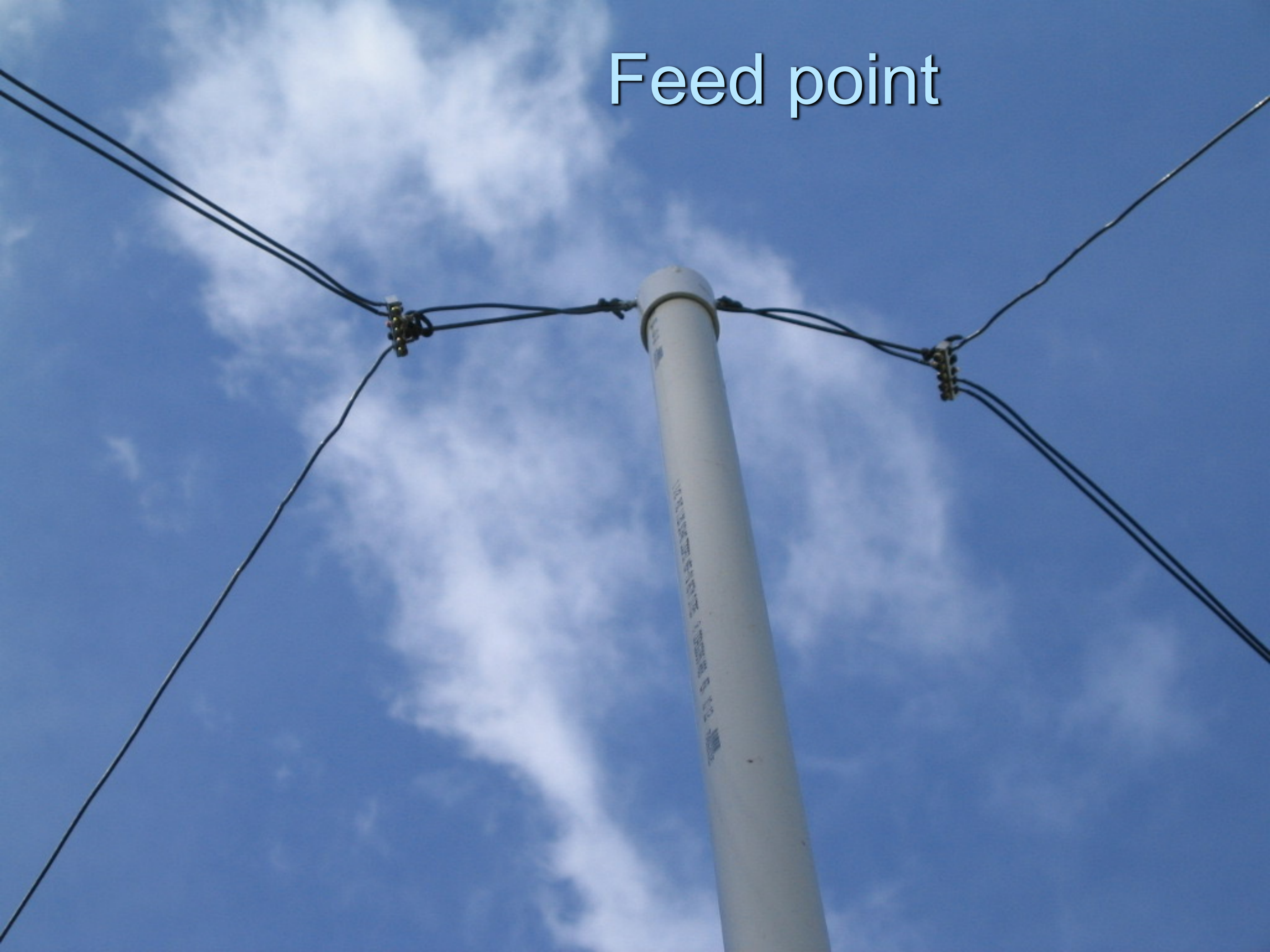
“T” Post



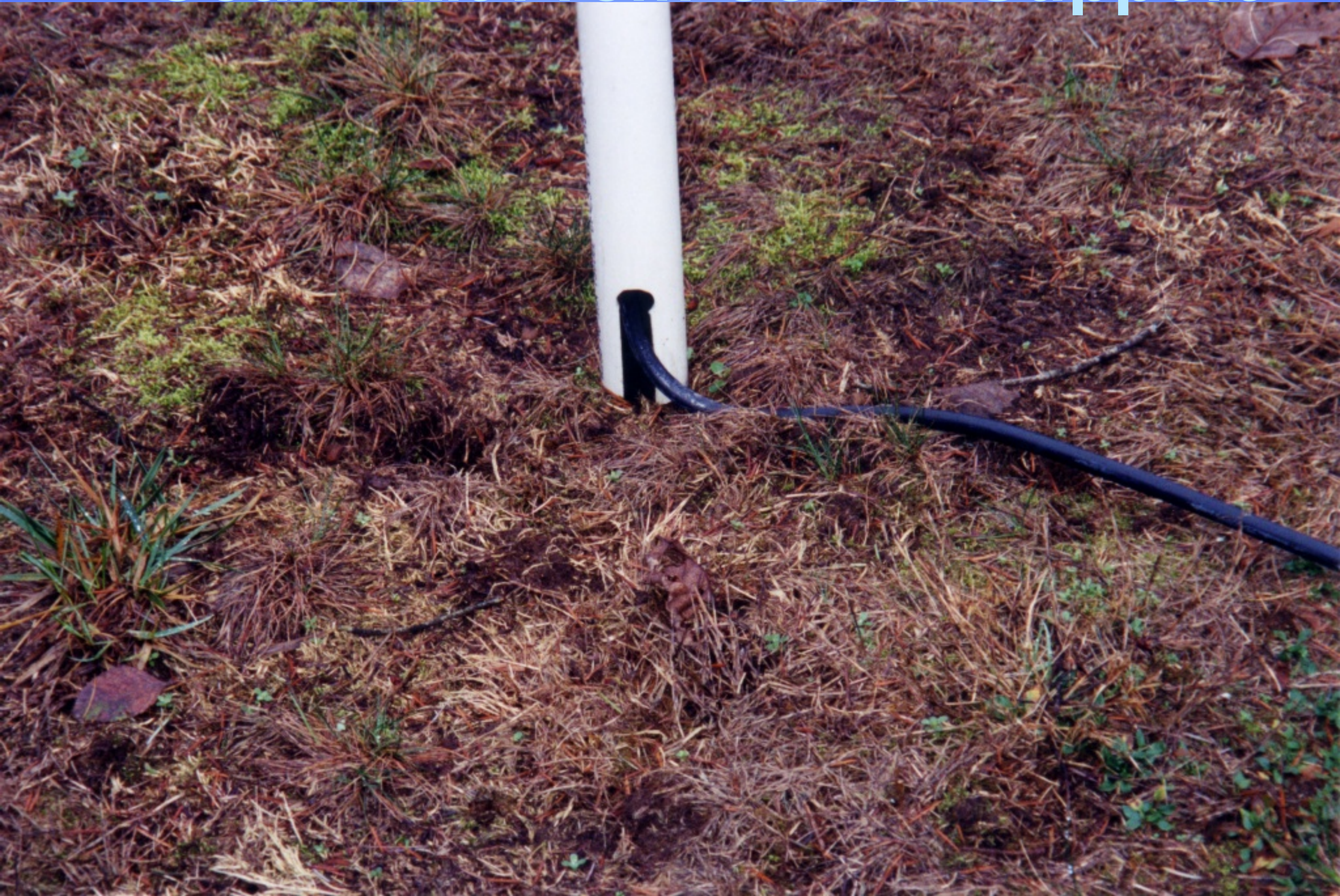
15’ Center Support



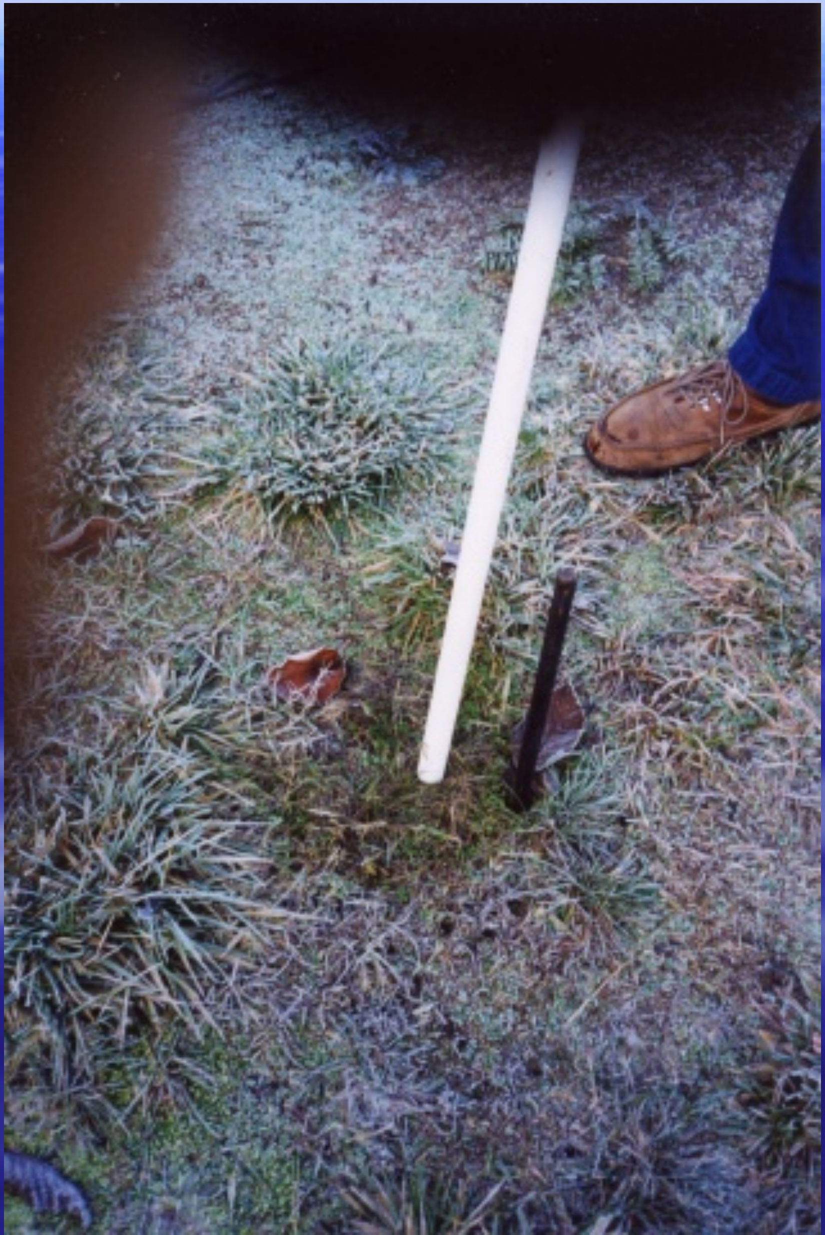
Feed point



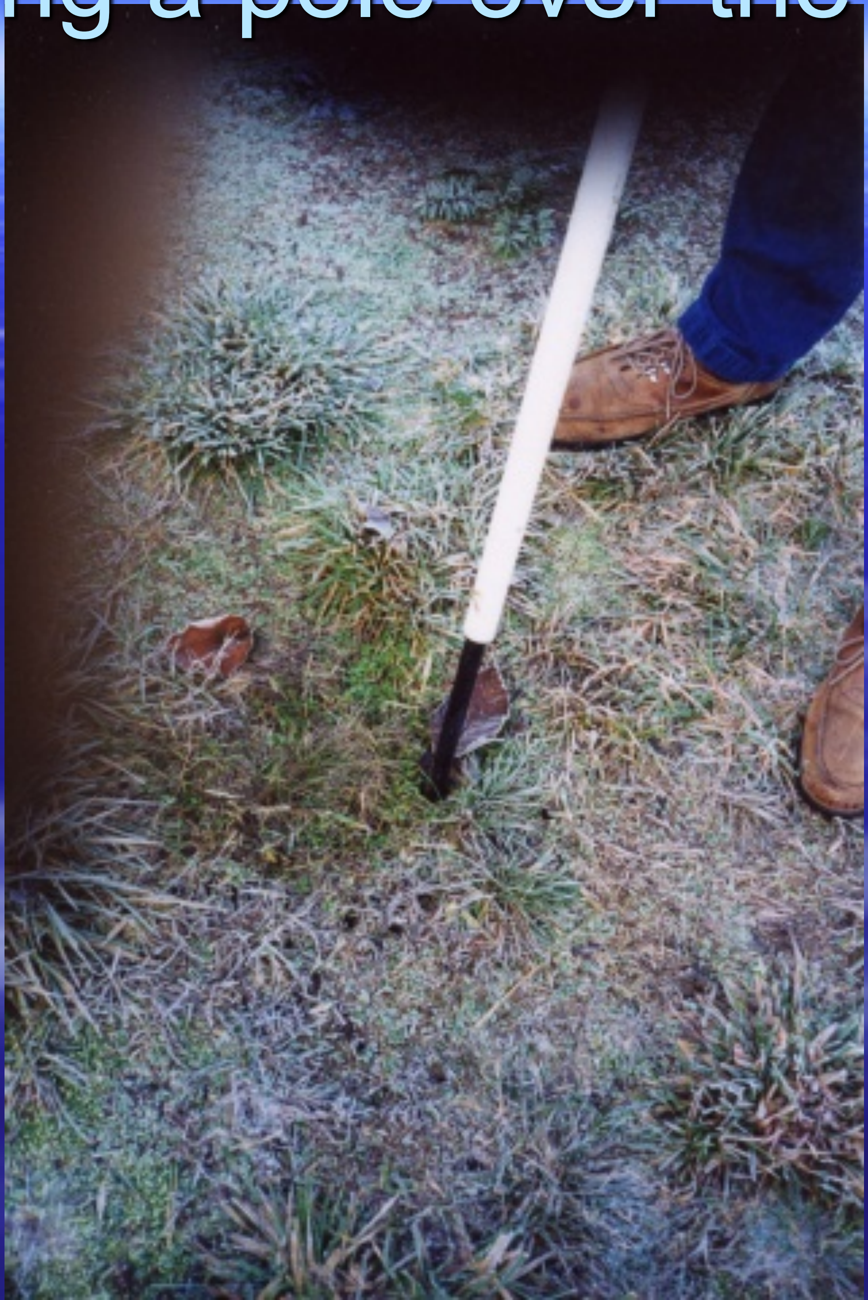
Coax Exit From Center Support

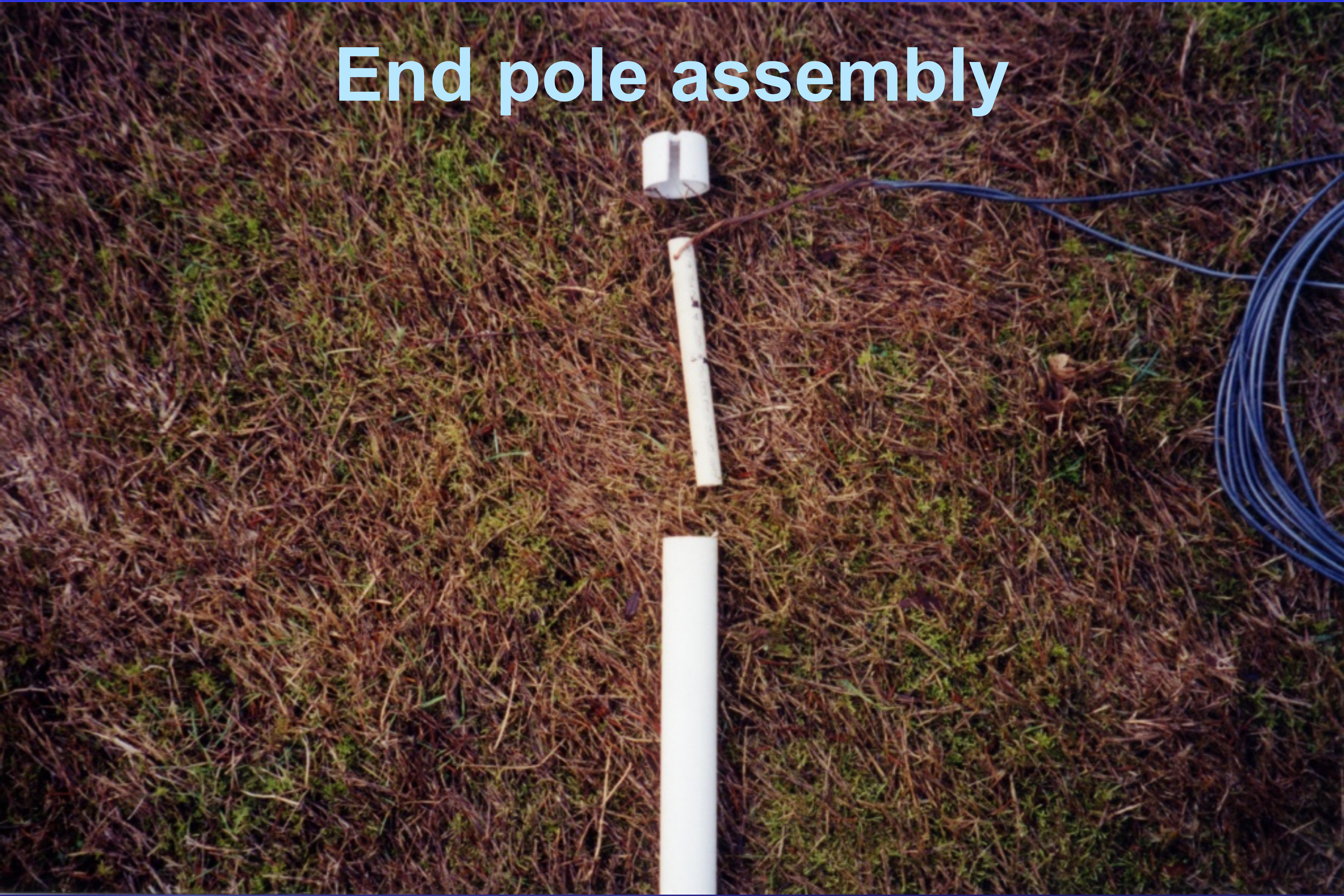


2.5’ end support and 18” stake



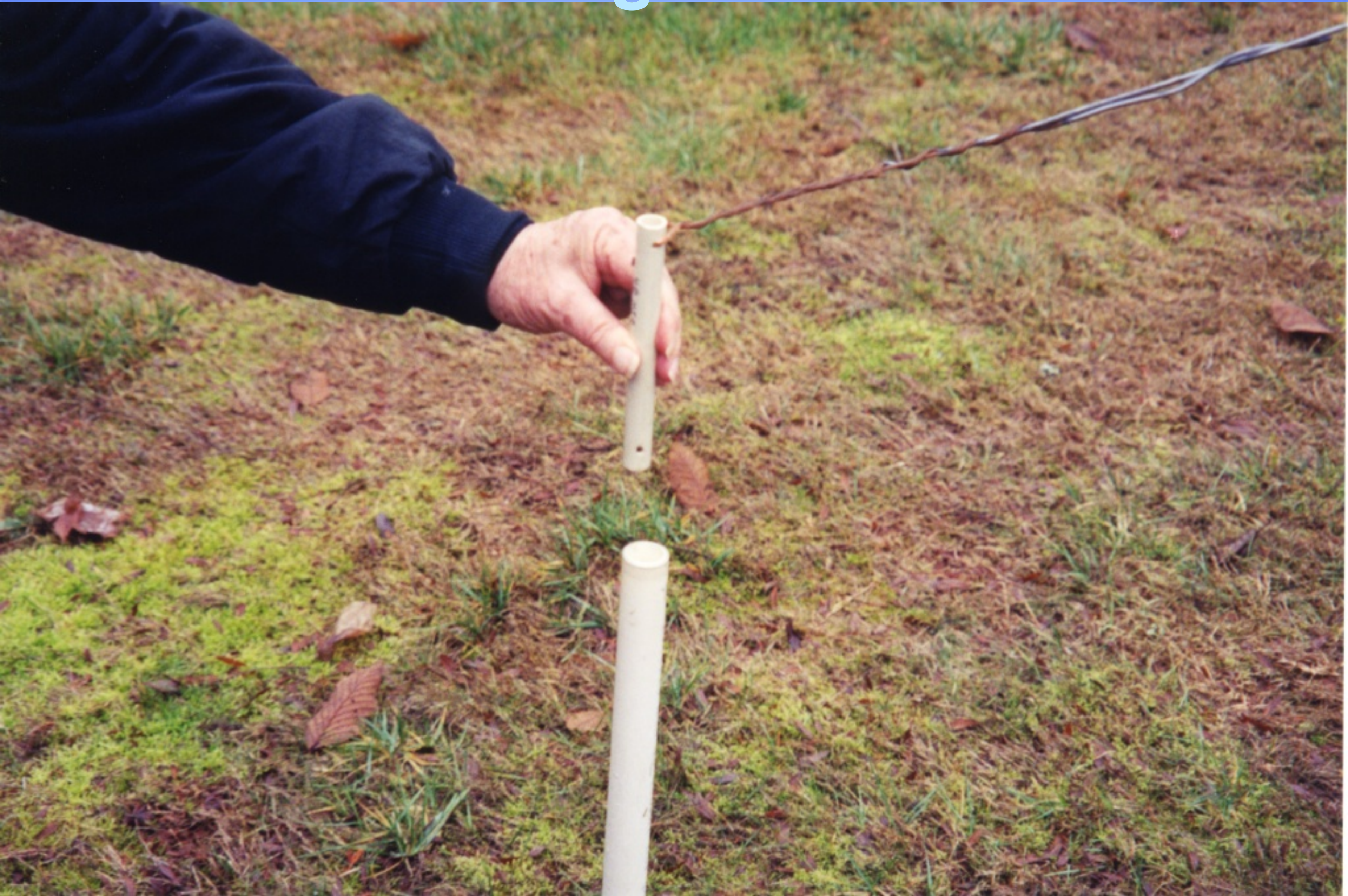
Slipping a pole over the stake



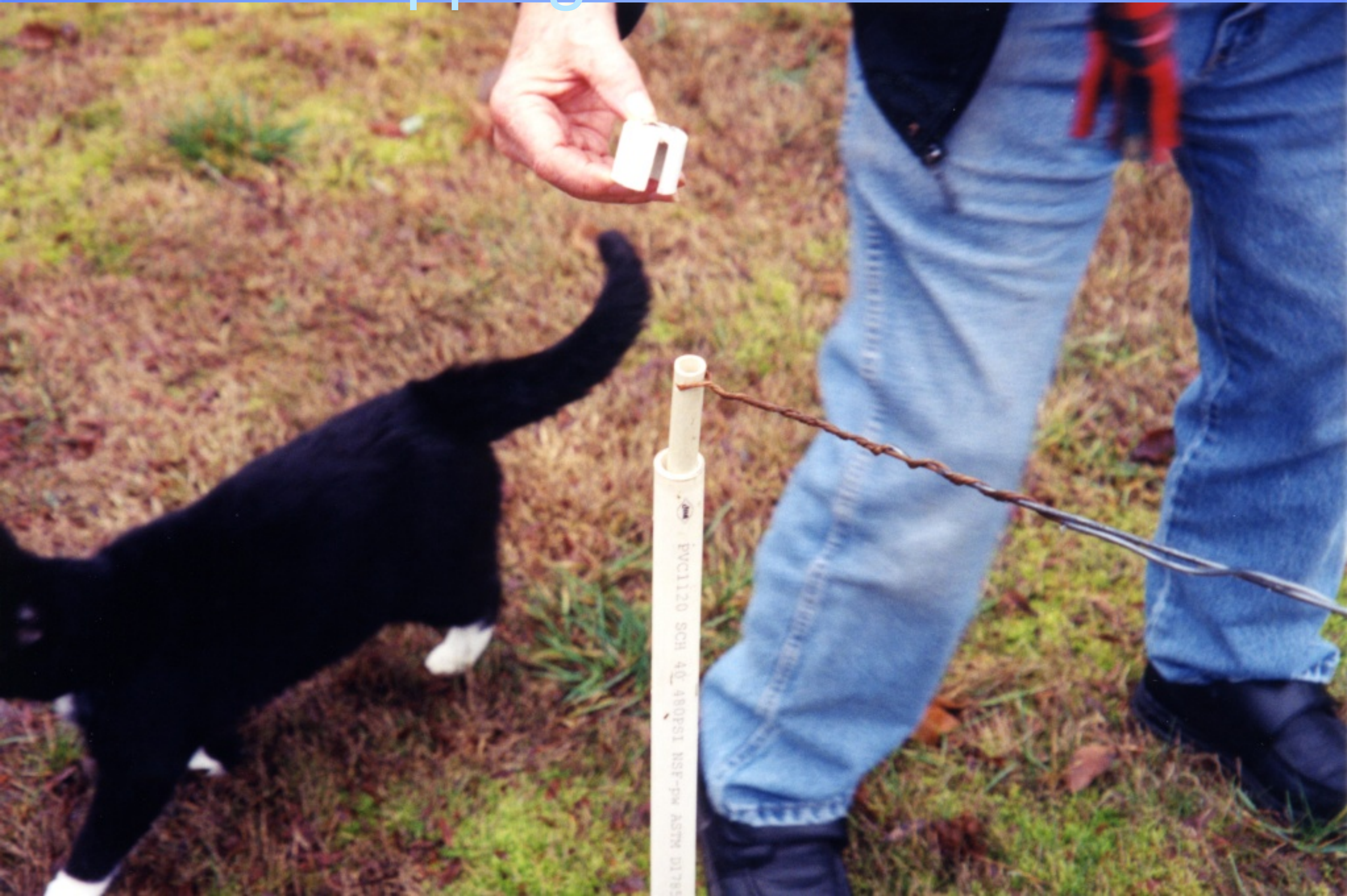


End pole assembly

Threading the Needle

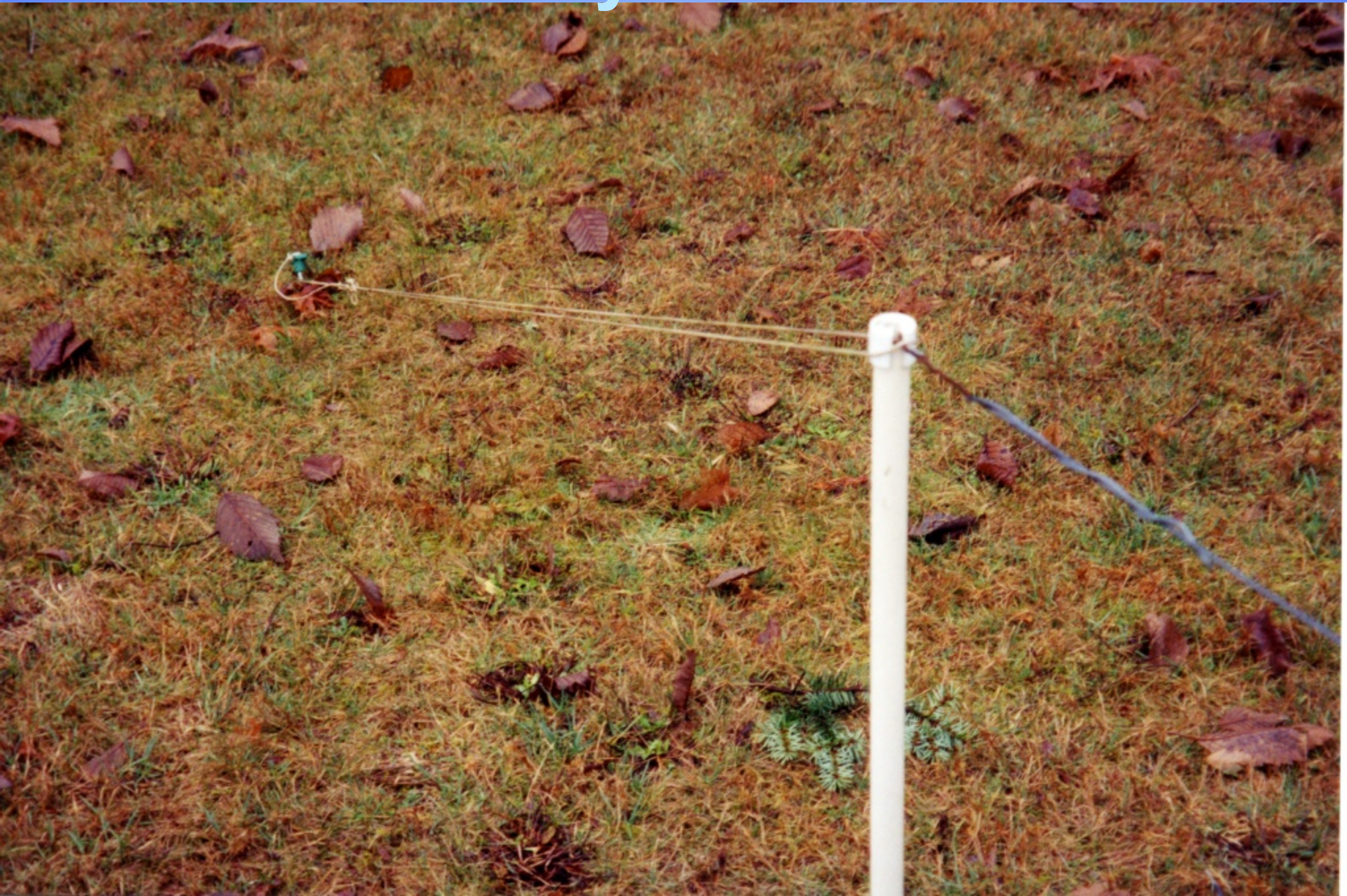


Capping the End Pole


PVC1120 SCH 40 480PSI NSF-pw ASTM D178

40 Mtr End Pole

Backstay for 75 Mtrs



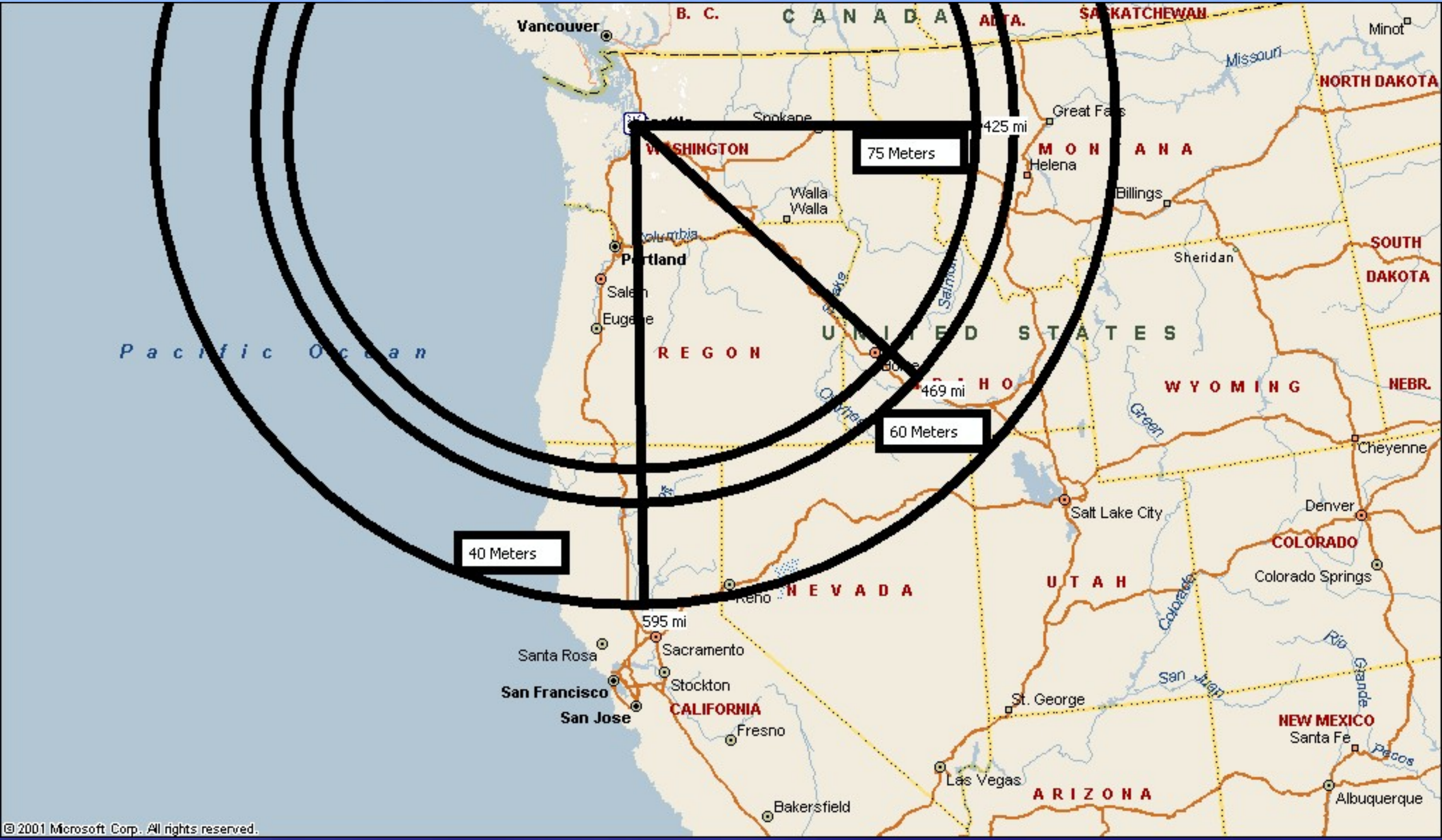
Does it work?

- Ed – Like gang busters!
- Tom – S meter pin buster!
- Field Day – Proved the theory. Worked WA, OR, ID, MT and CA as for South as Orange Co. Heard stations outside that radius but couldn’t work them
- Day to day operations – Not bothered by distant stations as much as those with higher antennas

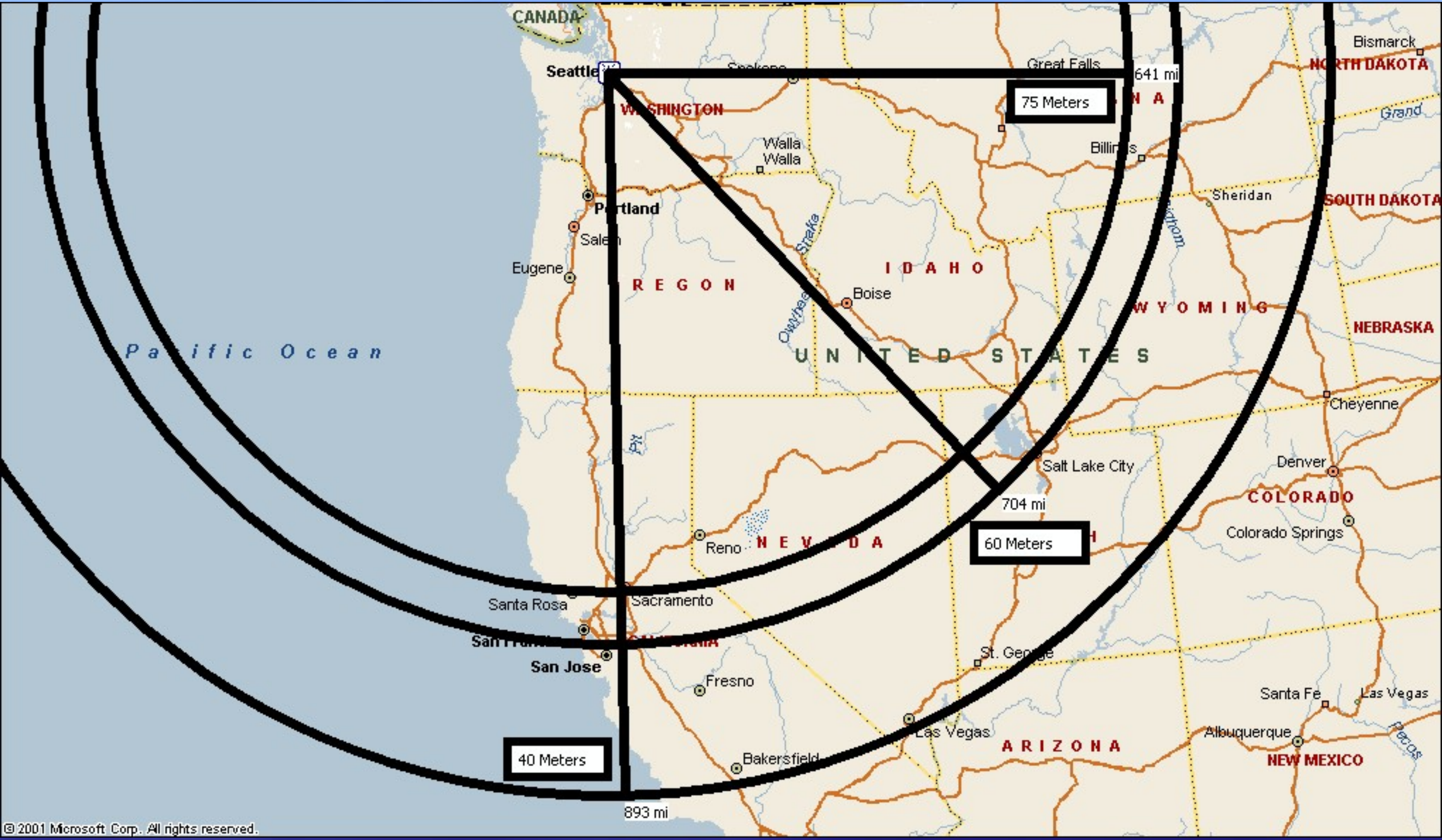
Beamwidth

75 Mtrs	43 deg. To 137 deg.
60 Mtrs	41 deg To 139 deg.
40 Mtrs	36 deg. To 144 deg.

Daytime 75, 60 & 40 Mtr Coverage



Nighttime 75, 60 & 40 Mtr Coverage



Does it work? (cont.)

- Slight resonant frequency shift with wet vs. dry conditions – lower when wet
- Meets requirement for single person operation
- Portability enhanced with use of non-tangling wire
- Permanent installations need to be reinforced against the wind

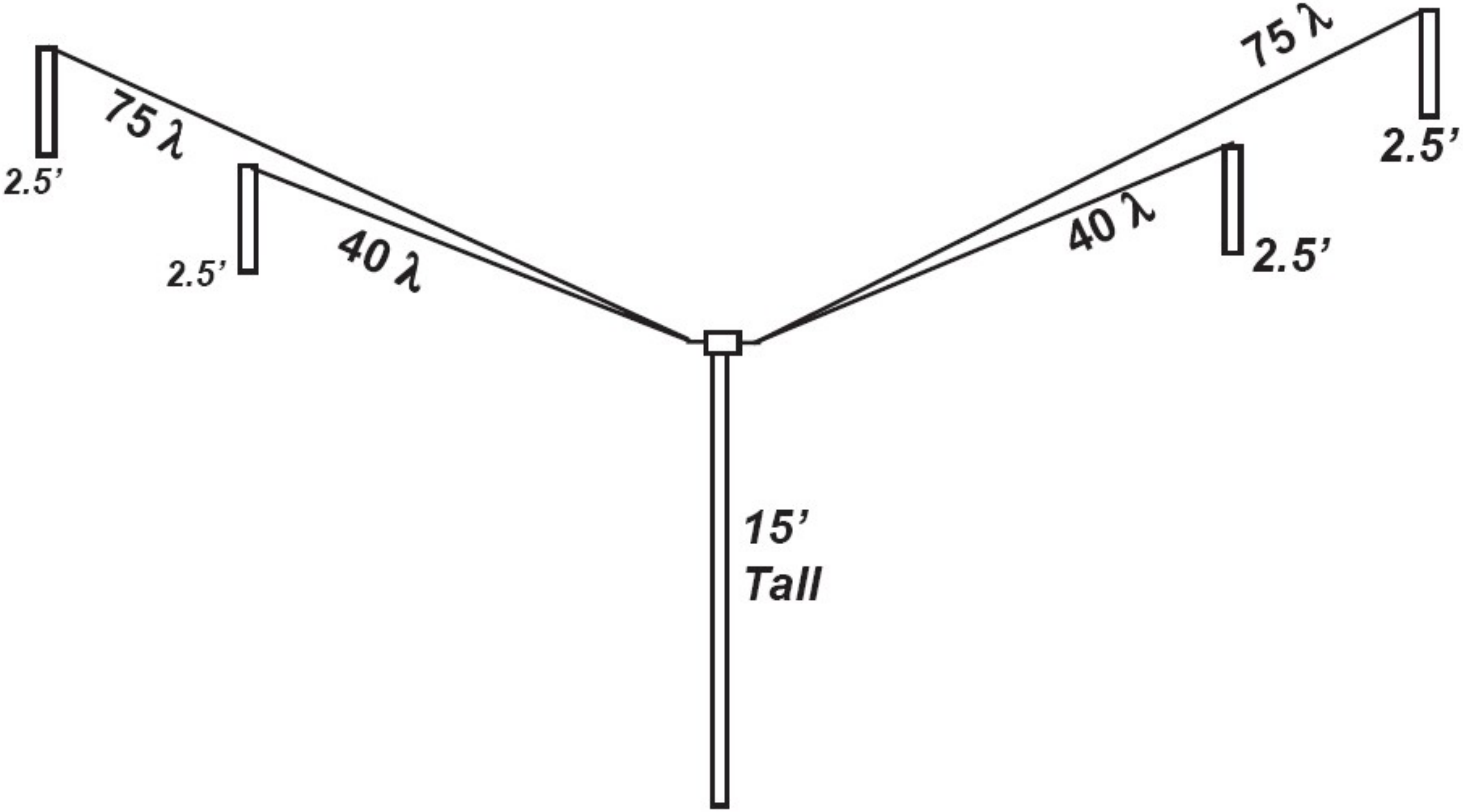
Tools required

- Hammer
- Screwdriver
- That’s it! There ain’t no mo!

Hints & tips

- Tin the feed point end of the wire – better mechanical fit for the ground bar
- Dipole insulator has an eye bolt in the top for suspension from a tree or skyhook
- When using suspension method, put 15’ mark on coax to ID the proper height
- Coax should be perpendicular to the ground

NVIS Dual-Band Antenna for 75, & 40 Meters.
Top View



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Safety considerations

- Flag end of wire – RF burn
- Insulated wire reduces possibility of RF burns
- Flag lower portions of wire for choking hazard prevention

60 Meter Considerations

- 5 Channels (Window freq. -1.5 kHz)
- 2.8 kHz bandwidth limitation
- USB
- 50W ERP

Regional 60 Meter Agreement

5405	Nation/International
5373	Washington
5368	Idaho
5348	Montana/Oregon
5332	Regional coordination between states/sections

Thank you!

de Ed & Tom